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FACULDADE DE FARMÁCIA, ODONTOLOGIA E ENFERMAGEM
PROGRAMA DE PÓS-GRADUAÇÃO EM ODONTOLOGIA

**ESTUDO CLÍNICO DE TÉCNICA DE REPOSICIONAMENTO DO BLOCO ÓSSEO
E IMPLANTES EM REGIÃO ANTERIOR DE MAXILA**

RAFAEL LIMA VERDE OSTERNE

FORTALEZA

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Tese apresentada ao Programa de Pós-Graduação em Odontologia da Faculdade de Farmácia, Odontologia e Enfermagem da Universidade Federal do Ceará, como requisito parcial para obtenção do Título de Doutor em Odontologia.

Área de Concentração: Clínica Odontológica

Orientador: Prof. Dr. Renato Luiz Maia Nogueira

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LISTA DE SIGLAS E ABREVIATURAS

3D – Tridimensional

BMPs – *Bone morphogenetic proteins* (Proteína morfogenética óssea)

CBCT – *Cone beam computed tomography* (Tomografia computadorizada de feixe cônico)

CT – *Computed tomography* (Tomografia computadorizada)

rHBMP2 – *Recombinant human bone morphogenetic protein 2* (Proteína morfogenética óssea humana recombinante tipo 2)

T1 – Período pré-operatório

T2 – Período pós-operatório imediato

T3 – Período pós-operatório tardio

VAS – *Visual analogue scale* (Escala visual analógica)

RESUMO

Atrofia óssea alveolar vertical representa um desafio para a reconstrução e reabilitação oral, especialmente quando envolve a zona estética da maxila. Quando a reconstrução óssea não é realizada, um bom resultado estético dificilmente é obtido. O objetivo deste estudo retrospectivo foi avaliar o resultado do reposicionamento do bloco osso-implante, após a osteotomia segmentar em pacientes com atrofia óssea alveolar vertical na região estética de maxila. Para a realização deste trabalho, foram selecionados pacientes com atrofia óssea alveolar vertical que se submeteram à reposicionamento do segmento de bloco osso-implante na região estética maxilar com um mínimo de 6 meses de acompanhamento. As variáveis avaliadas foram o índice de sucesso do implante, complicações após o procedimento cirúrgico, quantidade de aumento ósseo vertical, formação da papila, altura da faixa de mucosa ceratinizada e a análise de satisfação do paciente. Nove pacientes foram incluídos no estudo, todos com implantes múltiplos, totalizando 25 implantes. A média de aumento ósseo vertical foi de 4,9 mm (3,0-8,4 mm), e apenas 1 falha de implante ocorreu. Uma melhora estatisticamente significativa na formação de papila foi observada após a cirurgia, levando a um bom resultado estético. Mais de 2 mm de altura de mucosa ceratinizada foi observado em 6 pacientes, e também uma alta satisfação e aceitação ao tratamento. Após a avaliação dos dados concluiu-se que, a técnica apresentada possui a capacidade de reconstruir atrofia óssea alveolar vertical, com uma elevada taxa de sobrevivência de implantes em período curto de acompanhamento, melhorando o resultado estético-funcional com uma boa aceitação por parte dos pacientes.

Palavras-chave: Osteogênese por distração; implantes dentários; prótese dentária; osteotomia, cirurgia bucal

ABSTRACT

Vertical alveolar bone atrophy represents a challenge for reconstruction, especially when the esthetic zone of the maxilla is involved. When reconstruction is not achieved, a good esthetic outcome is rarely obtained. The aim of this retrospective study was to assess the outcome of implant-bone block movement, after segmental osteotomy in the maxillary aesthetic region in patients with vertical alveolar bone atrophy. Patients with vertical alveolar bone atrophy who underwent repositioning of the bone-implant block segment in the maxillary aesthetic region with a minimum of 6 months of follow-up were selected. Outcome measures were the success rate of the implant, complications after the surgical procedure, amount of vertical bone augmentation, papilla formation, keratinized mucosal band height and patient satisfaction analysis. Nine patients were included in the study, all with multiple implants, totaling 25 implants. The mean vertical bone augmentation was 4.9 mm (3.0-8.4 mm), and only 1 implant failure occurred. A statistically significant improvement in papilla formation was observed after surgery, leading to a good aesthetic result. More than 2 mm of height of keratinized mucosa was observed in 6 patients, and also a high satisfaction and acceptance to the treatment. After data evaluation, it was concluded that the technique presented can reconstruct vertical alveolar bone atrophy, with a high implant survival rate in a short period of follow-up, improving the aesthetic-functional result with a good acceptance by the Patients.

Keywords: Osteogenesis distraction, dental implants, dental prosthesis, osteotomy, oral surgery

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1 INTRODUÇÃO GERAL

Deficiência óssea vertical em processo alveolar de maxila e mandíbula pode ser um desafio para reabilitação dental com implantes osseointegrados, podendo gerar próteses com coroas longas, no sentido cérvico-incisal ou cérvico oclusal, gerando um comprometimento estético, principalmente em pacientes que necessitam de reabilitação de dentes anteriores e com linha do sorriso alta (Salama et al, 2009; Kim et al, 2012; Stacchi et al 2013). Diversas técnicas para contornar defeitos ósseos verticais são descritas na literatura, variando desde próteses com gengiva artificial até reconstruções ósseas com uso de bioengenharia (Eposito et al, 2009; Gomes-Ferreira et al, 2016; Daga et al, 2015; Yu et al, 2016; Yun et al, 2016).

O uso de gengiva artificial pode ser uma solução em casos de defeitos ósseos verticais (Coachman et al, 2009; Salama et al, 2009, Enríquez et al, 2016), defendido por alguns autores para simplificar o tratamento (Coachman et al, 2009); sendo a gengiva artificial em resina acrílica ou em porcelana, fixa ou removível, e com caracterização para mimetizar os tecidos moles vizinhos. Embora tenha sido descrita uma aceitação de até 96,8% do tratamento (Di et al, 2011), alguns autores falam da baixa aceitação e dificuldade de higienização como possíveis desvantagens (Enríquez et al, 2016).

Técnicas de reconstruções ósseas verticais podem ser empregadas antes da instalação dos implantes (procedimento em dois estágios) ou simultaneamente à instalação dos implantes (procedimento de estágio único) (Episoto et al, 2009). Dentre as técnicas de dois estágios podemos citar a distração osteogênica, enxerto ósseo interposicional (tipo sanduíche), uso de osso particulado protegido por membranas ou malhas de titânio, com ou sem o uso de BMP. Em comum à estas técnicas, a reconstrução óssea do defeito vertical

realizada previamente à instalação dos implantes gera aumento do tempo de tratamento e custos financeiros (Pérez-Sayáns et al, 2013; Mavriqi et al, 2015; Gomes-Ferreira et al, 2016).

Procedimentos de estágio único, como a técnica do *Bone Ring*, e o enxerto em tenda, apresentam vantagens de redução do tempo total de tratamento (Omara et al, 2016). Algumas desvantagens podem ser consideradas para estas técnicas, como a necessidade de um segundo sítio cirúrgico para a remoção do enxerto para a técnica de *Bone Ring*, ou mesmo para a técnica do enxerto em tenda, caso seja optado por uso de enxerto autógeno, o padrão ouro. Caso decida-se pelo uso de biomateriais, eleva-se o custo da técnica do enxerto em tenda, já que frequentemente é utilizado uma combinação de um substituto ósseo, membranas de colágeno e malha de titânio (Daga et al., 2015). Outro fator importante para a consideração em ambas as técnicas, é a necessidade de tecido mole suficiente para o recobrimento do enxerto sem tensão ao tecido, pois caso a tensão ocorra, o risco de exposição da área enxertada aumenta (Omara et al, 2016), podendo levar a falha do enxerto.

Diferente das técnicas descritas anteriormente, a reabilitação oral com auxílio da distração osteogênica clássica é realizada com um procedimento em dois estágios; primeiro a distração osteogênica propriamente dita, seguida pela instalação dos implantes (Chiapasco et al, 2004; Kim et al, 2013). Como principais vantagens desta técnica, encontra-se uma taxa consideravelmente rápida de neoformação óssea que, com ativação diária, pode chegar à 1mm ao dia, e a vantagem da formação de tecido mole associado à formação óssea (Herford et al, 2015). Como desvantagens da técnica os distratores convencionais usualmente apresentam custos elevados e costumam ser incômodos para o paciente, o que pode limitar a aceitação do tratamento (Eposito et al, 2009).

Watzeck et al, 2000, propuseram uma técnica alternativa de distração osteogênica realizada após a instalação dos implantes em áreas de defeitos ósseos verticais. Esta técnica apresenta similaridades com a técnica do reposicionamento de implantes mal-posicionados

por osteotomias em bloco do processo alveolar (Stacchi et al 2013). Em ambas as técnicas, duas osteotomias verticais e uma horizontal subapical aos implantes são realizadas, obtendo-se um bloco ósseo com os implantes. Na técnica do reposicionamento, os implantes são levados à posição desejada e fixados por meio de parafusos, placas ou mesmo pela união aos dentes vizinhos. Na técnica de Watzeck et al, 2000, um distrator multidimensional personalizado é fabricado e utilizado como intermediário do implante; com a ativação do distrator, o bloco ósseo contendo os implantes é levado à posição proteticamente ideal, consequentemente melhorando estética final do caso.

Ambas as técnicas de distração osteogênica de Watzeck et al, 2000, e a técnica de reposicionamento de implantes como relatada por Stacchi et al, 2013, são derivadas da osteotomia segmentar para cirurgia ortognática. A distração osteogênica de bloco ósseo com implantes, quando utilizada inicialmente por Watzeck et al, 2000, em 6 pacientes para a correção de 11 implantes, conseguiu-se um ganho ósseo no sentido vestibulo-palatino de até 4mm, e de até 11mm no sentido vertical. Dados similares aos de Zechner et al, 2001, que obtiveram um aumento ósseo vertical de 11 mm e de até 5 mm no sentido vestibulo-palatino; [neste estudo 8 pacientes foram tratados, totalizando 14 implantes]. Dentre as principais desvantagens desta técnica encontram-se a necessidade da confecção do distrator, o que pode elevar o custo do tratamento, e o desconforto do uso do distrator durante o período de distração e consolidação óssea.

Ueki et al, 2011, relataram um caso de distração osteogênica após a instalação dos implantes, no qual foi utilizado o aparelho ortodôntico para que o bloco ósseo fosse levado à posição desejada. A eliminação da necessidade de um distrator personalizado apresenta a vantagem de uma considerável redução de custos para o tratamento, porém pode ser questionado a previsibilidade do posicionamento final do bloco ósseo.

No presente trabalho, são apresentados uma técnica alternativa de distração osteogênica e um estudo retrospectivo com 9 casos tratados. Nesta técnica, foram realizadas as mesmas osteotomias utilizadas por Watzeck et al, 2000, para a obtenção do bloco ósseo com os implantes. Como modificação da técnica, foi realizada uma cirurgia prévia de modelo, para a obtenção de um guia cirúrgico final em resina acrílica, utilizado como distrator personalizado. Este foi ativado por meio de fio de aço, apresentando como vantagem a redução do custo quando comparado com os distratores personalizados descritos da técnica de Watzeck et al, 2000, e Zechner et al, 2001. Uma outra vantagem a ser considerada é a previsibilidade do procedimento, já que o guia cirúrgico personalizado em resina acrílica é confeccionado de acordo com o tamanho esteticamente favorável das coroas protéticas finais orientando de forma mais precisa a posição do bloco ósseo durante a cirurgia de modelo.

Em comparação com outras técnicas, o reposicionamento do bloco ósseo pode apresentar menor tempo total de tratamento, já que os implantes são instalados já no início, sem procedimentos prévios de aumento ósseo vertical; e menor custo, em comparação com uso de BMPs ou de distratores convencionais. Portanto, o presente estudo apresentou o objetivo de descrever uma técnica e avaliar retrospectivamente casos consecutivos tratados com osteotomia em bloco do processo alveolar após a instalação dos implantes em região anterior da maxila.

2 PROPOSIÇÃO GERAL

Avaliar retrospectivamente o índice de sucesso, movimento vertical do bloco ósseo, formação de papila, altura da faixa de mucosa ceratinizada e satisfação do paciente após cirurgia para reposicionamento de implantes através de osteotomia em bloco do processo alveolar em região anterior estética da maxila; assim como descrever uma técnica alternativa para a realização deste procedimento.

3 CAPÍTULOS

Esta tese está baseada no artigo 46 do regimento Interno do Programa de Pós- graduação em Odontologia da Universidade Federal do Ceará, que regulamenta o formato alternativo para dissertações de Mestrado e teses de Doutorado, e permite a inserção de artigos científicos de autoria ou co-autoria do candidato. Dessa forma, esta tese é composta por dois capítulos, contendo artigos submetidos ou a serem submetidos para publicação em revistas científicas, conforme descrito abaixo:

Capítulo 1

“Alternative Osteodistraction Technique after Implant Placement for Alveolar Ridge Augmentation of the maxilla”. Renato Luiz Maia Nogueira, Rafael Lima Verde Osterne, Ricardo Teixeira Abreu, Phelype Maia Araújo. Este artigo foi submetido para publicação no periódico *“Journal of Oral and Maxillofacial Surgery”*.

Capítulo 2

“A retrospective study of an alternative osteodistraction technique after implant placement in the maxillary esthetic region”. Rafael Lima Verde Osterne, Renato Luiz Maia Nogueira, Ricardo Teixeira Abreu, Roberta Barroso Cavalcante, Érica Amaral Medeiros Este artigo será submetido para publicação no periódico *“Clinical Oral Implants Research”*.

CAPÍTULO 1

Title: Alternative Osteodistraktion Technique after Implant Placement for Alveolar Ridge Augmentation of the maxilla

Running title: Alternative osteodistraktion technique

Key words: dental implant; osteodistraktion; vertical alveolar bone atrophy; osteotomy

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Abstract

An alternative technique to reconstruct atrophic alveolar vertical bone after implant placement is presented. The technique consists of an osteodistraction or direct surgical repositioning of an implant-bone block segment after segmental osteotomies that can be used in esthetic or non-esthetic cases. Initially, casts that transfer the implant position are obtained and the future ideal prosthetic position is determined to guide the model surgery. After the model surgery, a new provisional prosthesis is made, and an occlusal splint, which is used as both a surgical guide and a device for osteodistraction, is custom-fabricated. The surgery is then performed; for the mobilization of the implant-bone block segment, two vertical osteotomies are performed and then joined by a horizontal osteotomy. The implant-bone block segment is then moved to the planned position. If a small movement is planned, the implant-bone segment is stabilized; in cases that require larger movements, the implant-bone segment may be gradually moved to the final position by an osteodistraction. This technique has a low cost, a good predictability of the final implant-bone segment position, and relatively fast esthetic rehabilitation; it may be considered in cases of dental implants in regions of vertical bone atrophy.

Introduction

Different techniques may be used for oral rehabilitation in cases with vertical alveolar bone atrophy.¹ Some of these techniques may be used before the dental implant installation (two-stage procedures), such as the tent-pole graft technique, guided bone regeneration, and grafts stabilized by titanium mesh, which can lead to time-consuming reconstruction and high treatment costs.² Other techniques may be used at the same stage of the implant surgery (one-stage procedures), such as the bone ring technique and the tent-pole technique, which can reduce the overall time of treatment.³ Osteodistraction is a technique usually used before an implant is installed, to reconstruct large bone defects, avoiding both bone graft procedures and the use of bone substitutes, thereby avoiding a second surgery site and reducing the cost of bone substitutes, and it can present the benefits of recreating both soft and hard tissues.¹

Alternatively, the use of multidimensional osteodistraction to move implant-bone block segments into a prosthetically desirable positions was described initially by Watzek et al,⁴ 2000, using custom-fabricated distractor abutment to move a dental implant. Zechner et al,⁵ 2001, described additional cases using the technique proposed by Watzeck et al,⁴ 2000; and Zauza et al,⁶ 2004, described custom-made traction prostheses; but the use of custom-made devices, such as distractor abutment and traction prosthesis, may lead to higher cost treatments. Latter, Marcantonio et al,⁷ 2008, and Carlino et al,⁸ 2016, proposed the use of tooth-implant supported distractor to move dental implants, but only in vertical direction, as is the use of a distraction implant described by Gaggl et al,⁹ 2000, and the use of an adhesive prosthesis with a cylinder to guide the implant repositioning described by Mendonça et al,¹⁰ 2008. Ueki et al,¹¹ 2011, used an alternative method with an orthodontic device to move an implant-bone block segment into a prosthetically desirable position, although the distraction obtained is multidimensional, it is not clear how to control the final positioning of the implant-bone block segment. In the present technical note, we report the use of a custom-

made acrylic resin device for osteodistraction or the direct surgical repositioning of the implant-bone block segment that has a good outcome predictability due to the use of a surgical guide.

Technical note

The technique described herein is used in cases of vertical alveolar bone reconstruction, after the implant insertion, in the maxilla, in esthetic or non-esthetic regions, such as the patient shown in figure 1. Initially, an impression is made using the direct technique (open tray), using a dimensionally stable material such as regular-body polyvinyl siloxane, and dental stone type IV is poured into this impression to obtain a definitive cast. The casts are then mounted in a semi-adjustable articulator, and the future ideal prosthetic position is determined, by a diagnostic wax-up, which will then guide a model surgery. The model surgery is performed (Figure 2) by simulating the osteotomies, with two vertical and one subapical implant osteotomy in casts. In cases of multiple implants, whenever necessary, the obtained block can be segmented if different movements are planned for the implants. The block containing the implant is positioned in the final desired position and then stabilized with dental stone type IV.

After the model surgery, a new provisional prosthesis with the correct dimensions is made. After new provisional crowns are made, an occlusal splint of acrylic resin reinforced with orthodontic wire is custom-fabricated to obtain a surgical guide, which will guide the implant-bone block segment to the final planned position during the surgery. In cases of single implants, a buccopalatal perforation is done in the provisional crown; in cases of multiple implants, the crowns must be kept joined at proximal surfaces with acrylic resin. A perforation, or union of the crowns, is required and passed through an orthodontic wire, which is then activated by twisting the wire to lead the implant-bone block in the direction of the surgical guide and the final planned position. The surgical guide must cover all teeth so that the guide does not move; in cases where there is no good stability, the guide can be fixed to the posterior teeth, thus increasing the stability.

For the surgery, the new provisional prosthesis is screwed to the implant. Under general or local anesthesia, a horizontal incision is made in the unattached mucosa extending along the extent of the defect, and a mucoperiosteal flap is elevated (Figure 3). The bone surrounding the implant is then cut with a saw or a 701 carbide bur; two vertical osteotomies are performed and then joined by a single horizontal osteotomy. The implant-bone block segment is then mobilized with a thin chisel. The occlusal splint is positioned, and orthodontic wire is passed through either the prosthesis perforation (in cases of single implants) or the interproximal region (in cases of multiple implants) and then passed through the splint. The implant-bone block segment is moved to the planned position, and the wire is activated by twisting and sliding the implant-bone block in the direction of the surgical guide and the final planned position. If a small movement is planned, the implant-bone block segment can be stabilized with internal rigid fixation; in cases that require longer movements, the implant-bone block segment may be gradually moved to the final position by osteodistraction. In cases of osteodistraction, some movement of the implant-bone block segment occurs during surgery (approximately 3 mm of vertical movement), and it can be activated by the surgeon on the seventh post-operative day. The time period for distraction is dependent on the amount of augmentation planned. After the movement is completed, the implant-bone block segment needs to be immobilized for 12 weeks; this is done via the union of the provisional prosthesis with adjacent teeth using an orthodontic wire (Figure 4). After this period, prosthetic procedures for the final prosthesis may be performed (Figure 5).

Discussion

In the present article, an alternative treatment to oral rehabilitation in areas with vertical alveolar bone atrophy is presented. This technique has a lower cost, in comparison with conventional osteodistraction, because the device is made of acrylic resin reinforced with orthodontic wire. It also has a good predictability for the final implant-bone segment position because a model surgery is initially performed and a custom-fabricated device serves as a surgical guide. Another positive aspect of the technique presented is the relatively fast esthetic rehabilitation, as a provisional crown with a length that favors the esthetic is installed during the surgery and osteodistraction. After surgery, early preparation of the definitive prosthesis takes approximately 14 weeks. Two to three activations on average are performed to reach the planned position of the bone block, and another 12 weeks are required for bone stabilization and consolidation. During the immediate postoperative period, the use of systemic antibiotics is necessary to prevent infections. During the period of distraction, greater hygienic care is necessary, and the use of chlorhexidine is indicated for oral hygiene.

Another option in cases of vertical bone atrophy is the use of artificial gingiva, which can successfully reestablish natural crown ratios and significantly improve the esthetic results. The total length of treatment is also shortened, as this procedure usually reduces the number of surgical procedures needed.¹²⁻¹⁴ The disadvantages are mainly related to acceptance and psychological issues related to patient expectations,^{12,13} particularly in patients with high lip lines in which the transition between the natural and artificial gingiva may be visible when smiling.¹⁴ Additionally, the use of artificial gingiva usually requires complex oral hygiene for maintenance.¹²⁻¹⁴ Although an additional surgery is necessary for the technique described here, it appears to be beneficial as it induces the formation of soft tissue along the bone formation¹ and simplifies oral hygiene.

Some considerations should be made concerning the selection criteria for these cases. First, the patient should have sufficient horizontal bone volume for the implant installation, or horizontal bone grafting should be performed beforehand. Regarding vertical bone height, it should be at least 10 mm high, so that a minimum of an 8 mm implant can be installed. A minimum apical height of 2 mm is necessary so that the osteotomy can be performed. The distance between the implant and the neighboring teeth should allow for an osteotomy that is 2 mm away from the roots of the neighboring teeth, thus reducing the risk of root damage or heating that may lead to pulpal necrosis. In cases of multiple implants, these should be designed to allow for a minimum distance of 3 mm between implants, especially for external hexagon platform implants.^{15,16} Cases with less than 3 mm may result in bone crest resorption and the formation of compromised papillae. The neighboring teeth should have good periodontal health, and the implants must also have good peri-implant health after their installation and prior to the repositioning surgery.

This technique is contraindicated in the following cases: patients with vertical bone remnants of less than 10 mm in height, in which implants with a length of less than 8 mm would be required; in cases where there are reduced distances between the implants (less than 3 mm) and between the tooth/implant (less than 2 mm); and in cases with vertical bone resorption in the neighboring teeth. Patients with systemic impairments, such as uncontrolled diabetes mellitus and immunosuppression, as well as patients who use drugs that inhibit bone metabolism and patients with areas of irradiated bone, should not undergo this technique. Caution should also be exercised when using this technique on patients who smoke, as smoking has a negative effect on bone healing.¹⁷

Potential complications of this technique such as the loss of implants and the risk of periodontal defects must be mentioned, especially in cases of osteotomies performed with a distance of less than 2 mm from the neighboring teeth, which may also increase the risk of

pulpal damage. This technique also presents the risks inherent to osteogenic distraction,¹⁸ such as the risk of segment necrosis, so segments smaller than 6 mm in length should be avoided. The risk of bone non-union is associated with a high rate of distractor activation, which in a conventional distraction is 1 mm per day.¹⁸ In the technique presented, the rate of activation was not completely controlled. In a single activation, it may reach up to 3 mm in the gap, but this activation does not occur daily and should have intervals of 4 to 7 days. Although the bone gap at the apex of the implants in a single activation exceeds what is recommended for daily activation, there is always interproximal bone contact, which reduces the risk of bone non-union. Larger intervals of activation may generate an early bone union and limit vertical bone gain.^{18,19}

Other potential complications include the risk of suture dehiscence,¹⁸ which can be minimized with proper horizontal incision placement approximately 5 mm from the mucogingival junction and the absence of vertical incisions. Some studies have also reported resorption of the bone crest with the use of osteogenic distraction that can reach approximately 20% of the movement,^{18,20} especially in cases where bone movement exceeds 10 mm. Therefore, an overcorrection could be considered for cases with large bony movement requirements.²¹

The drawbacks of this method include the necessity for horizontal bone grafts before the implant installation in cases of horizontal deficiency and the need to use a custom-made device, similar to an occlusal splint, during the osteodistraction. However, in cases of small vertical movements, the device is used only during the surgery; in such cases, the implant-bone segment can be stabilized by internal rigid fixation or with an orthodontic device. Furthermore, although osteodistraction induces the formation of soft tissue,¹ the presence of keratinized mucosa is necessary for a positive outcome.²² Therefore, it may be necessary to use keratinized tissue augmentation techniques during the installation of the implant or during

the second-stage surgery, as keratinized mucosa may be absent in vertical alveolar bone atrophy.

A possible improvement for this technique may be the use of computer-aided design and manufacturing (CAD/CAM) to guide osteotomies, thereby reducing surgical time and the risk of damage to neighboring teeth.^{23,24} Osteotomy guides are already used in orthognathic surgery and orthodontic treatment, and there are reports of its use in osteogenic distraction.²³⁻²⁵ Kang et al,²⁴ 2016, reported on the use of a surgical guide adapted to the maxillary bone after flap elevation to perform an osteotomy between teeth and posterior osteogenic distraction. The use of an alternative surgical guide was reported by Casseta et al,²³ 2015, which was used from the moment of the incision until the osteotomy. The guide proposed by Casseta et al,²³ 2015, would not be the most suitable for the technique described in the present article because the use of this guide would imply the need for vertical incisions, which could generate tension at the angles during bone block movement and increase the risk of dehiscence of the suture and exposure of the bone block. The guide proposed by Kang et al,²⁴ 2016, seems to be more suitable for the present technique.

Oral rehabilitation in areas of vertical alveolar bone atrophy is complex and presents a real clinical challenge that is best treated using a multidisciplinary approach. Although the outcomes of this technique are encouraging, more clinical cases are necessary to validate the technique; to date, this procedure was performed in 13 patients, 12 of them in maxillary esthetic region, some cases with a follow-up as long as 72 months. Although different treatment options are proposed in the literature, the presented technique may be considered for dental implants in cases of vertical bone atrophy.

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Figure 1: A 40-year-old female patient with vertical alveolar bone atrophy in the anterior region of the maxilla, involving the region of the four maxillary incisors, was submitted for dental implants. In the frontal clinical view, a provisional prosthesis with long clinical crowns and an unfavorable esthetics (A); the clinical view shows the vertical alveolar bone deficiency, and a good width of keratinized mucosa was obtained after the second stage surgery (B).

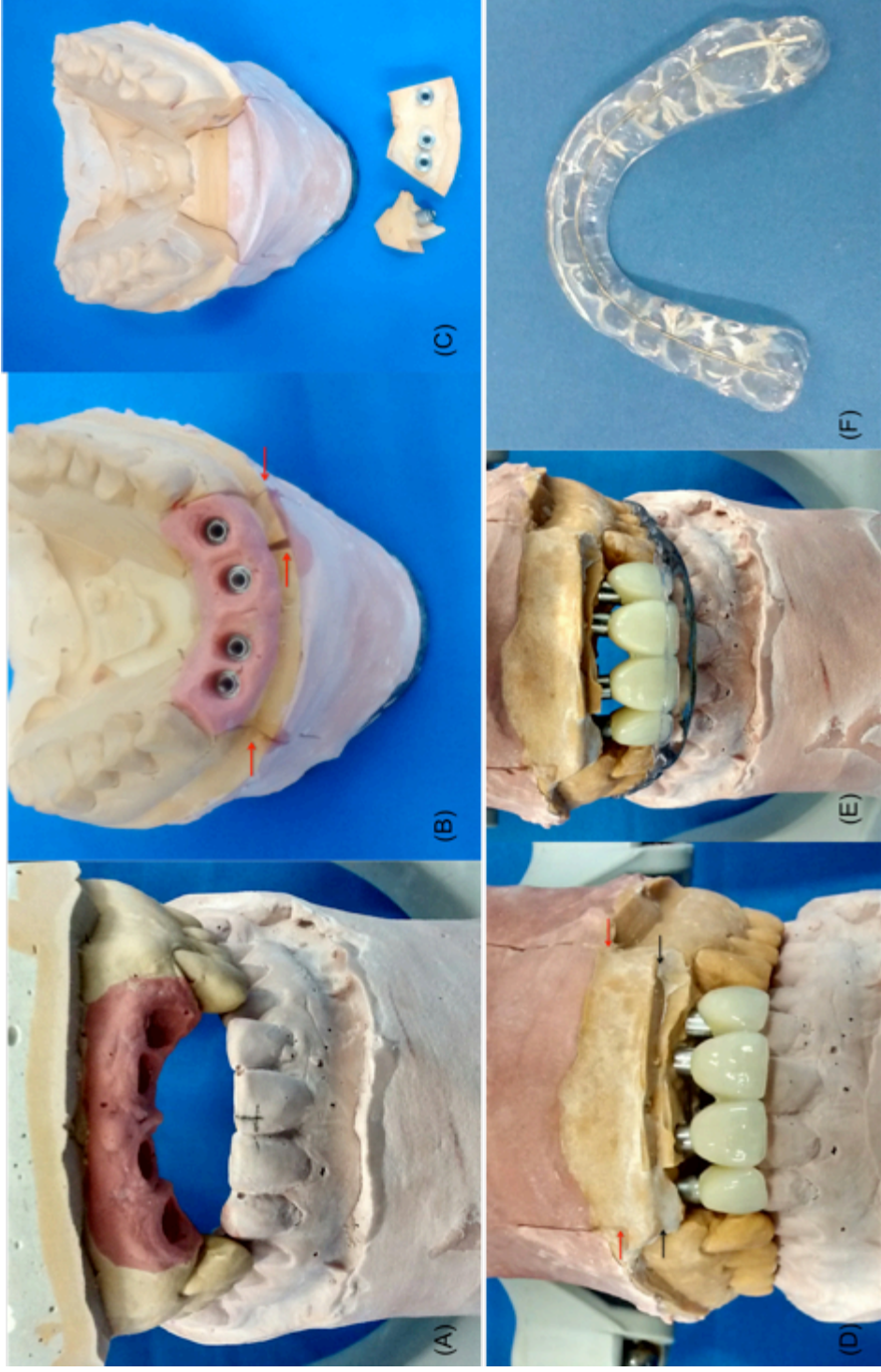


Figure 2: Model surgery. Casts were obtained and mounted in an articulator (A). The osteotomies were performed in casts (B; red arrows); in this case, after obtaining the block, it was necessary to separate the implant in the region of maxillary right lateral incisor, which resulted in two blocks, one containing 3 implants and the other containing only one (C). The blocks containing the implants were positioned in the final desired position and stabilized with dental stone type IV, and a new provisional prosthesis was made (D; red arrow showing the original position; black arrow showing the final position); an occlusal splint of acrylic resin was fabricated to guide the implant-bone block segment to the planned position (E and F).

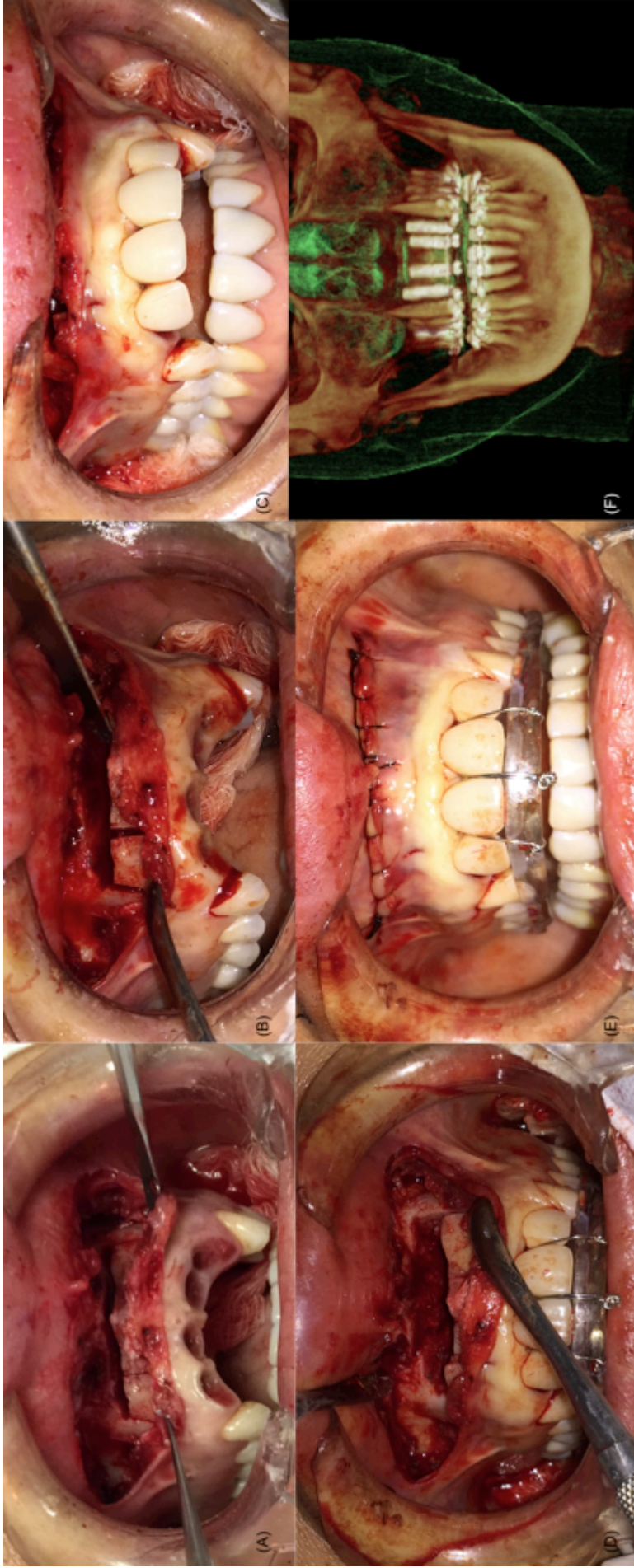


Figure 3: Surgical procedure. Under local anesthesia, a mucoperiosteal flap was elevated after a horizontal incision in the unattached mucosa. Two vertical osteotomies were performed distally to the implants, and one additional vertical osteotomy was placed between the implants in site of maxillary right lateral and central incisors. A horizontal, subapical implant osteotomy was performed to achieve the union of the vertical osteotomies, and the bone segments were mobilized (A). A more detailed view of the vertical osteotomy between the implants is shown in B. The new provisional prosthesis was positioned (C) and moved toward the desired position using the occlusal splint (D). The immediate post-operative period indicated that the complete planned movement could not be completed because the provisional prosthesis could not slide to the final position in the occlusal splint (E), and additional activation for osteodistraction was performed a week later. An immediate post-operative 3D CT reconstruction showed the gap formed after the implant-bone block segment movement (F).



Figure 4: Osteodistraction. The osteodistraction was performed until the provisional prosthesis slides to the final position (A), and the implant bone block segments were immobilized for 8 weeks (B).

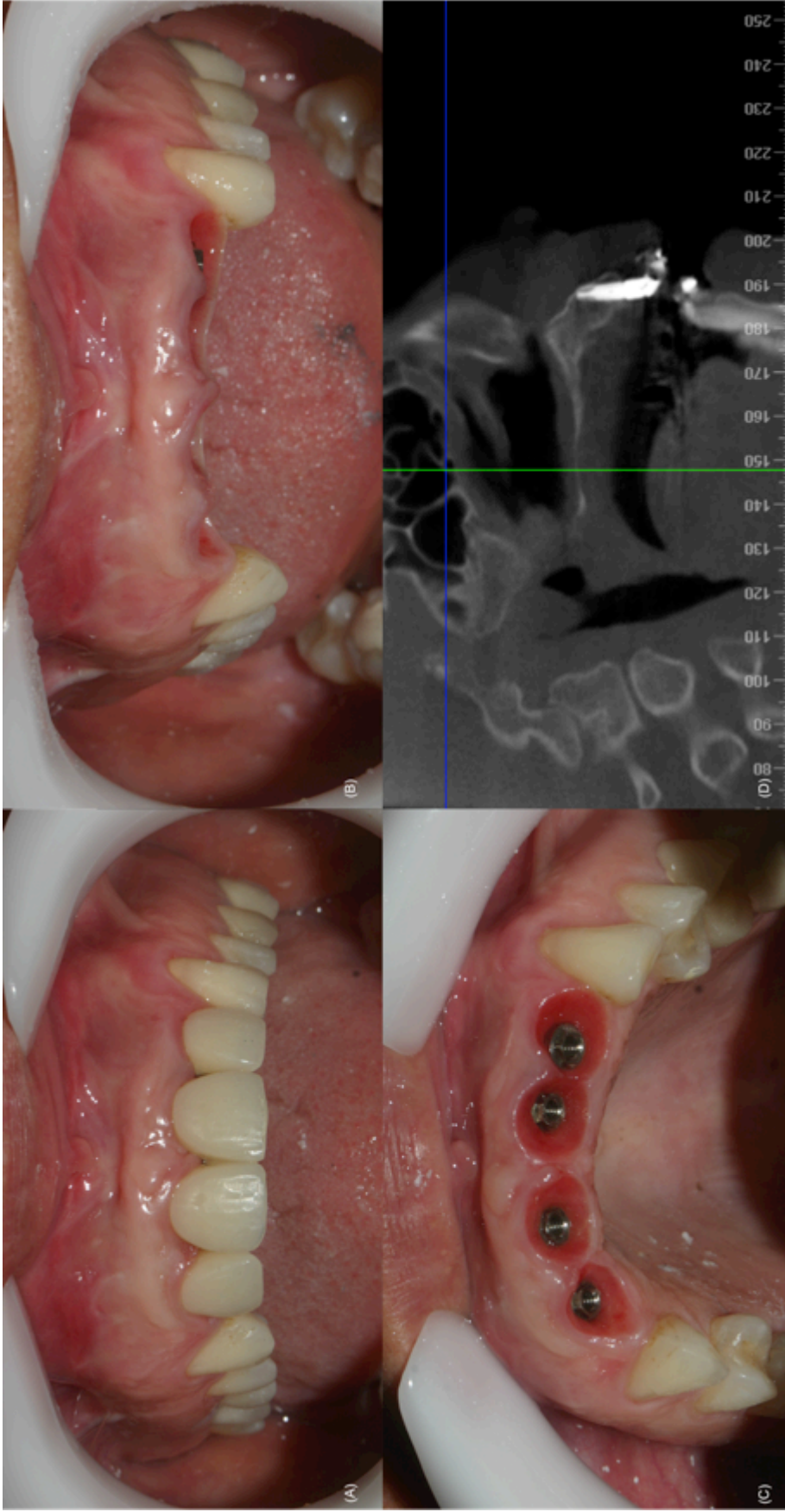


Figure 5: Clinical intraoral view of the final rehabilitation, showing considerable papilla formation, more than 2 mm of keratinized mucosa width and an improvement of esthetics (A, B and C). Sagittal slices of a CT in the implant in site of maxillary right central incisor showed bone formation in the region of the bone gap (D)

CAPÍTULO 2

Title: A retrospective study of an alternative osteodistraktion technique after implant placement in the maxillary esthetic region

Running title: Alternative osteodistraktion technique

Key words: dental implant; osteodistraktion; vertical alveolar bone atrophy; osteotomy

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Abstract

Aim: To assess implant-bone block movement, gingival outcome and the subjective appreciation of patients after an alternative treatment involving relocation of an implant-bone block segment in the maxillary aesthetic region of patients with vertical alveolar bone atrophy.

Materials and methods: Patients who underwent implant-bone block segment relocation for reconstruction of maxillary vertical alveolar bone atrophy in the anterior esthetic region were assessed. The outcome measures were implant failure, complications after initial loading, vertical bone augmentation, papilla index, width of the keratinized mucosa and patient satisfaction. The minimum follow-up length was 6 months.

Results: Twenty-five implants in 9 consecutive patients were included in the present study. During the follow-up period, only 1 implant failed. Vertical bone augmentation ranged from 3.0 to 8.4 mm (mean 4.9 mm). A significant improvement ($p < 0,001$) in the papilla index in either the implant-implant papilla or dental-implant papilla was observed, improving the esthetic outcome. Six patients (66.6%) had more than 2 mm of keratinized mucosa, and all of the patients were satisfied with the treatment.

Conclusion: The esthetics and functional gingival outcome of oral rehabilitation in areas with vertical alveolar bone atrophy can be successfully improved with the presented technique, which had a high overall implant survival rate within a short-time period.

Introduction

Vertical alveolar bone atrophy represents a challenge for reconstruction, especially when the esthetic zone of the maxilla is involved. When reconstruction is not achieved, a good esthetic outcome is rarely obtained. Bone grafts for horizontal bone atrophy have high rates of success, with survival rates ranging from 90.2 to 100% after 3 years of evaluation when autologous bone grafts were used (Chiapasco et al., 2004; Kim et al., 2013). In cases of vertical bone atrophy, different techniques may be used including guided bone regeneration (GBR) with titanium mesh or membranes reinforced with titanium (Urban et al., 2009), intraoral distractors (Mohanty et al., 2015; Yun et al., 2016), the bilaminar cortical tenting grafting technique (Yu et al., 2016), the tent-pole technique using screws or implants (Daga et al., 2015), the sandwich osteotomy (Mavriqi et al., 2015), and others. In all of the previously cited techniques, bone regeneration is usually realized before the installation of the dental implant, which requires longer treatment durations and high financial costs (Mavriqi L et al, 2015; Gomes-Ferreira et al, 2016; Pérez-Sayáns et al, 2013).

The use of a non-absorbable and dimensionally stable barrier is usually necessary (Urban et al., 2009) to prevent the collapse of the grafting material. A limitation is the amount of soft tissue available for covering the graft material to prevent early exposure of the membrane. One option is the use of osteodistraction, which can reconstruct both soft and hard tissues (Eposito et al. 2009). Traditionally, osteodistraction is used before dental implant installation. Alternatively, Watzek et al. (2000) has proposed a multidimensional osteodistraction that can be carried out after implant placement. This procedure involves the use of a custom-fabricated distractor abutment that can move the dental implant into a prosthetically desirable position following segmental osteotomy (Watzek et al., 2000).

Watzek et al. (2000) used multidimensional osteodistraction in 6 patients to correct 11 dental implants and achieved success in all cases, with movements of the implant-bone block segment as long as 11 mm in the vertical direction and 4 mm in buccal/palatal direction. Following the first description of the technique, Zechner et al., 2001, treated 8 patients with a total of 14 dental implants and achieved a maximum vertical movement of 11 mm and a maximum buccal/palatal movement of 5 mm. Later, Zauza et al., 2004, described the fabrication and function of a custom-made traction prostheses for one-, two- or three-dimensional osteodistraction. Other case reports and clinical studies of osteodistraction for

repositioning dental implants using different techniques have been published (Oduncuoglu et al., 2011; Ueki et al., 2011; Mendonça et al., 2008; Gaggl et al., 2000), but the literature lacks clinical investigations that analyzed the gingival esthetic outcomes of this treatment.

Another similar procedure is the direct relocation of the implant-bone block to the desired position with immediate stabilization by internal rigid fixation (Stacchi et al., 2013; Tavares et al., 2013). When used in cases of vertical alveolar bone atrophy, this technique may reconstruct bone atrophy and restore esthetics in the anterior maxillary region. Only a few cases using this technique have been reported (Tavares et al., 2013; Cunha et al. 2011, Kassolis et al., 2003; Toscano et al., 2011); only one retrospective study has analyzed the gingival esthetic outcome, but the cases in this study all involved the repositioning of single implants (Stacchi et al., 2013). Therefore, the aim of this retrospective clinical study was to assess the success of dental implants, the implant-bone block movement, the gingival score and the patients' subjective appreciation of the final results after an alternative, low-cost treatment involving relocation of the implant-bone block segment in the maxillary aesthetic region of patients with vertical alveolar bone atrophy.

Methods

The patients selected for this study were all consecutive patients with vertical alveolar bone atrophy who underwent relocation of the implant-bone block segment in the maxillary aesthetic region at a private clinic in Fortaleza, Ceará, Brazil, which was operated by a single surgeon. This study was approved by an ethical committee (Protocol 1.757.767), and written informed consent was obtained from all patients. The patients were selected on the basis of the following inclusion criteria: patients with vertical alveolar bone atrophy in the anterior region of the maxilla with teeth that presented distally to the areas of bone atrophy, allowing for fitting of the surgical guide; patients who underwent relocation of the implant-bone block segment in the maxillary aesthetic region; patients who presented with clinical frontal intraoral photography before and at least 6 months after surgical treatment; and patients who underwent cone beam computed tomography (CBCT) before and immediately after surgical treatment. The exclusion criteria for this study were as follows: cases in which the clinical intraoral photography was of inadequate quality; cases with incomplete clinical records; and also cases in which the implant-bone blocks were carried out during orthognathic surgery.

Surgical and prosthetic procedures

Initially, an impression was obtained, and the position of the implants was obtained using a diagnostic cast. The ideal future prosthetic position was then determined using a diagnostic wax-up. A model surgery was performed, and the implants were positioned in the final desired location and stabilized with dental stone. With the implants in the final position, a new provisional implant-fixed prosthesis was made. If it was a single implant, a buccal/palatal perforation was performed on the prosthesis. If there were multiple implants, they were kept splinted together at the proximal surfaces. The perforation or the union of the provisional prosthesis were passed with an orthodontic wire, which led the prosthesis to the planned position during the surgery. An occlusal tooth-implant-supported splint of acrylic resin reinforced with orthodontic wire was custom-fabricated for use as a surgical guide.

For the surgical procedure, the new provisional implant-fixed prosthesis was positioned in the implant, and then a horizontal incision was made in the unattached gingiva, exposing the region of the alveolar process segment to be osteotomized. The bone surrounding the implant was then cut through with a saw, and two vertical osteotomies were performed. They were then connected by a single horizontal osteotomy, and the implant-bone block segment was mobilized with a thin chisel. The occlusal splint was positioned, and the orthodontic wire was passed through the perforation of the prosthesis (in the case of a single implant) or through the interproximal region (in the case of multiple implants) and then passed thru the splint. The implant-bone block segment was then moved to the planned position. If a small movement occurred, the implant-bone block segment could be stabilized with internal rigid fixation. In cases of large movements, the implant-bone block segment could be gradually moved to the final position by an osteodistraction. After the movement was completed, the implant-bone block segment was immobilized for 12 weeks. This was performed by connecting the provisional prosthesis to the adjacent teeth with an orthodontics wire. After this period, the prosthetic procedures for the final prosthesis could be performed.

Data collection

Data from the medical records, clinical photographs and CBCT images were collected from the following three different periods: before the implant-bone block surgery (T1), immediately after the repositioning of the implant-bone block (T2), and 6 months after the surgery (T3).

The outcome measures were the following:

1. Implant failure including mobility of the implants (determined manually) and/or any infections requiring implant removal that were present at the abutment connection or at the insertion of the provisional prosthesis. These data were obtained from the medical records.
2. Complications occurring during/after treatment. These data were also obtained from the medical records.
3. Evaluation of the vertical bone augmentation.

Vertical bone gain was evaluated by linear measurement of the vertical bone gap found at the apex of each implant involved in the movement, and an average of the measurements was calculated. This measurement was taken from a sagittal slice of the post-

operative CBCT (T2) image using Dolphin 3D imaging software® with the linear measurement tool.

4. The papilla index according to Jemt 1997 in T1 and T3. This index describes the papillae in relation to the height of the interproximal space. Score 0: no formation of papillae; Score 1: less than half of the interproximal space filled with soft tissue; Score 2: formation of papillae in at least half of the interproximal space; Score 3: papillae filling the entire interproximal space; Score 4: hyperplastic papillae. This score was determined for all of the papillae involved in the movement of the implant-bone block based on frontal intraoral clinical photographs. Intra-examiner agreement was assessed and demonstrated statistically significant agreement (Kappa, 869).

5. Width of keratinized mucosa

The keratinized mucosa was assessed in clinical pictures from after the surgery in T3. The measurement was made after calibration of a digital ruler using the actual length of the distance between the distal surface of the maxillary right central incisor and the distal surface of the maxillary left central incisor. After, a calibrated ruler was used to measure the width of the keratinized mucosa from the most apical point of the gingival margin to the mucogingival junction. The distance was categorized as “no keratinized mucosa”, “between 0-2 mm of keratinized mucosa”, or “>2 mm of keratinized mucosa”.

6. Evaluation of patient satisfaction

Subjective evaluation of patient satisfaction was assessed during the T3 period based on the results of the questionnaire of Meijndert et al., 2007, which was modified by Tymstra et al., 2010. The questionnaire consisted of an overall satisfaction score ranging from 0-10 and two questions regarding the peri-implant mucosa with scores ranging from 0 to 4. Additionally, two questions about discomfort and compliance were evaluated based on a VAS score (Stacchi et al., 2013).

Statistical analysis

All data were compiled into a single electronic dataset, and all analyses were performed using SPSS, version 16.0 (SPSS Inc., Chicago, IL, USA). Age and follow-up time are expressed as the means and standard deviations. Vertical bone augmentation is expressed as the mean. The width of the keratinized gingiva and patient satisfaction are expressed as

percentages. The Wilcoxon signed-rank test was used to evaluate the papilla scores, and the level of significance was set at 5%.

Results

During a period from 2010 and 2016, 13 consecutive patients underwent repositioning of implant-bone block segments. Of them, only 9 patients were included in the present study. Two were excluded because the repositioning was performed during an orthognathic surgery; 1 was excluded because the repositioning was in the posterior region of maxilla; and 1 was excluded due to a short period of follow-up (less than 6 months). The nine remaining patients included 2 men and 7 women with ages ranging from 25 to 62 years (mean 44.8 ± 13.1 years). None of the patients had significant anamnestic remarks. A total of 25 implants were repositioned, and the mean length of follow-up was 33.8 months (± 23.3 months; ranging from 6 to 72 months). In all of the cases, multiple implants were moved, and no cases of single implant repositioning were performed during this period. In two cases, implant-bone blocks containing 4 implants were moved (Figure 1); in 3 cases, implant-bone blocks containing 3 implants were moved; and in 4 cases, implant-bone blocks with 2 implants were moved (Figure 2 and 3). Four of the patients underwent bone grafts prior to implant placement due to horizontal bone atrophy. The data are presented in Table 1.

During the follow-up period, only one implant failure occurred. The failure was diagnosed during the abutment connection in a patient who underwent implant-bone block repositioning with three implants in the block, and the mesial implant (at the maxillary right central incisor site) failed. All of the other implants are still functional with provisional or definitive prosthetic rehabilitation. Although an implant apex was sectioned during the horizontal osteotomy in one case (patient 6; implant in the maxillary central left incisor site; Figure 4), the implant did not fail. Other complications occurred after surgery in two patients. Although a minimal distance of 2 mm between the osteotomy and natural teeth was respected, dental root therapy was necessary for one tooth each in two patients (patient 9, maxillary right lateral incisor; patient 5, maxillary left lateral incisor), as tooth discoloration occurred, and the pulp vitality test was non responsive.

The mean vertical bone augmentation measured at T2 was 4.9 mm, ranging from 3.0 mm to 8.4 mm. Internal rigid fixation was used in only case, which involved an implant-bone block segment with 2 implants (patient 2, implants in the maxillary right lateral and central incisors site) that were repositioned only 3.0 mm.

The papilla indices are listed in Table 2. In total, 35 papilla were analyzed. Eighteen

were implant-natural teeth papilla, and 17 were implant-implant papilla. The scores at T1 were relatively low, indicating poor gingival esthetics before surgery. At this time point, 25 (71.43%) papillae had scores ranging from 0 to 1, with 16 of them at the implant-implant site and 9 at the implant-natural tooth sites ($p = 0,004$). After surgery (at T3), a statistically significant improvement in the papilla scores was observed ($p < 0,001$). Only 7 (20.00%) papillae had scores ranging from 0 to 1, with one of them at the implant-natural tooth site and 6 at the implant-implant sites ($p = 0,028$) [Graphic 1]. When analyzing the keratinized mucosa at T3, only one case had at least one implant without keratinized mucosa, two cases had between 0 to 2 mm of keratinized mucosa, and 6 cases had keratinized mucosa >2.0 mm.

Patient feedback regarding the treatment is presented in Table 3. The worst overall score was 7, meaning that all patients were satisfied or very satisfied with the treatment results. Regarding gingival contour, 66.6% were satisfied or very satisfied, and 88.9% were satisfied or very satisfied with the gingival color. Regarding the discomfort of the surgery, 4 (44.4%) patients considered it to be moderate, and 2 (22.2%) experienced high discomfort. Only 2 (22.2%) patients stated that they would be reluctant to undergo this procedure again if needed, and none of the patients stated that they would not undergo the surgery again.

Discussion

Reconstruction of alveolar vertical bone atrophy is a complex clinical challenge for oral rehabilitation, and a multidisciplinary approach is frequently necessary to achieve good esthetic results. Some decades ago, the criteria for implant success included no clinical mobility, a lack of symptoms, no radiographic peri-implant radiolucencies, and less than 0.2 mm of annual bone loss after the first year (Albrektsson et al., 1986). Although some cases may be functional and present with all of the previous criteria of success, as in Figure 2C, it is unclear if these should be considered cases of successful treatment or successful osseointegration. Some might consider them to be examples of successful osseointegration but a failure of the treatment, as good aesthetic results were not achieved.

The options when faced with vertical alveolar bone atrophy vary from prosthetic compensation of the soft tissue to bone reconstruction using bioengineering (Coachman et al., 2009; Eposito et al., 2009; Herford et al, 2015). The costs and treatment times are reduced when only artificial gingiva (ceramic or acrylic resin) is used. However, these treatments can be complex, time-consuming, and high-cost, requiring bone grafts associated with titanium mesh and rHBMP2 (Gomes Ferreira 2016). The treatment presented in this study may be suitable for correcting bone defects in aesthetic areas with satisfactory results and reduced cost compared with traditional osteodistraction or the use of bioengineering. Because the device used is made of acrylic resin reinforced by orthodontic wire, it is a low-cost device. The treatment involves two stages. First, the implant is installed, and then the reconstruction surgery is performed. Other reconstructions such as tent-pole or bone ring techniques involve only one stage, which leads to a reduction in total treatment time (Daga et al., 2015; Omara et al., 2016). Though more time consuming, the presented technique can achieve aesthetic results in a similar time frame since the provisional prosthesis used in the repositioning surgery is already the proper size.

This technique was shown to be reproducible in the cases evaluated, with good predictability due to the use of surgical guides. Another advantage of this technique is that it can be used for distraction osteogenesis, as in cases that involve repositioning the implant in one session (patient 2), as well as for malpositioned implants. After mobilization of the implant-bone block segment, all downward movements can be performed in one step if the palatal soft tissue allows. If the downward movements cannot be performed precisely due to a lack of elasticity of the soft tissue, an osteodistraction is performed. Ideally, osteotomies on

the buccal bone plate should be initiated with burs or saws and finished using thin chisels, thus avoiding damage to the periosteum of the palate that could compromise the blood supply to the implant-bone block segment.

Vertical alveolar bone augmentation was assessed by linear measurement of the bone gap in a CBCT image. The mean bone augmentation was 4.9 mm, but a case of 8.4 mm of vertical augmentation was observed in patient 9. Previous authors have reported 11 mm of vertical alveolar reconstruction by means of osteodistraction of the implant-bone block segment (Watzek et al., 2000; Zechner et al., 2001). In the present study, the model surgery was used to determine all bone augmentations. In cases of multiple implants, different movements of the implants can be performed whenever necessary by segmenting an implant to an isolated bone block. However, this should also be planned in advance during the model surgery, as was the case in one patient from this study (patient 1).

Complications occurred in 4 patients, and one patient's implant failed. In this patient, an autogenous bone block graft was performed prior to implant placement. The implant at the maxillary right central incisor site still had mobility during the provisional prosthesis phase following the repositioning surgery, so the patient decided not to remake the implant. The overall implant survival rate was 96% during the follow-up period. Recently, a study by Chrcanovic et al., 2016, reported a survival rate of 98.36% up to abutment connection, regardless of the technique used. One patient had the apex of an implant sectioned during osteotomy, but the implant did not fail. After a follow-up period of 54 months, the implant had satisfactory esthetics and function. Two of the patients exhibited a loss of pulp vitality (one tooth each) in the neighboring teeth to the osteotomy site. Although a limit of 2.0 mm of distance between the osteotomy and the natural tooth was respected, two teeth evolved with discoloration and a lack of response to the pulp vitality test. Both were lateral incisors, so perhaps due to the smaller diameter of the root of the tooth, a greater distance of the osteotomy should be recommended.

To explore the clinical significance of papilla indices, the data were sorted based on papilla and papilla location (implant-implant papilla or implant-natural tooth papilla). The scores at T1 were relatively low, indicating the presence of compromised papilla, with 71.43% of the papillae being classified as "no formation of papillae" or "less than half of the interproximal space filled with soft tissue". As expected (Tymstra et al., 2010), the inter-implant papilla had a worse score than the implant-natural tooth papilla, and 64% of the

papillae classified as 0 or 1 were in the implant-implant site. After treatment, only 20.0% of the papillae were classified as 0 or 1, showing a significant improvement of papillae presence both in the implant-implant site and the implant-natural tooth site. Although more papillae were observed at T3, the effects of the bone repositioning on the formation of the papillae are unclear. It can be considered that the bone repositioning reduced the distance from the interproximal contact point to the inter-implant bone peak, favoring filling of the papilla space and improvement in the papilla indices. However, it is worth mentioning the importance of tissue manipulation techniques with provisional crowns for the formation of papillae (Wittneben et al., 2013), which was also performed in the cases described in this study.

A good width of keratinized mucosa was observed in 6 out of 9 of the patients in the study. Often in cases of bone atrophy, keratinized mucosa may not be present, and techniques to increase the amount of keratinized mucosa may be performed during implant installation or second-stage surgery. The presence of keratinized mucosa has a positive effect on peri-implant tissue health (Ladwein et al., 2015; Bassetti et al., 2016). In a systematic review, Bassetti et al., 2016, found that patients with sites with a width of <2 mm of keratinized mucosa developed discomfort during brushing more easily and also exhibited dental plaque accumulation and peri-implant soft tissue inflammation.

The overall satisfaction of the patients was high, which was in agreement with the improvement in papilla formation and the reduction in the length of the tooth crowns observed in the present study. The procedure was found to have good compliance, as 66.6% of the subjects would undergo this treatment again, if necessary, and the discomfort was considered not high (only 2 patients [22.2%] experienced high discomfort). Stacchi et al., 2012, observed similar results after repositioning single dental implants through segmental osteotomy, but no osteodistractions were performed in their study.

A number of limitations should be taken into account when interpreting the results of this study. First, this is retrospective clinical study and not a randomized, controlled clinical trial. Second, although this procedure was performed on 13 patients, only 9 patients were analyzed, and such a limited sample size greatly affects the statistical power.

Conclusion

The osteodistraction presented here can successfully reconstruct vertical alveolar bone atrophy in the anterior region of the maxilla without increasing implant loss in a short time period. Additionally, this procedure can significantly increase the gingival esthetics and is well accepted by most patients with only moderate discomfort. Clinical trials with larger numbers of patients comparing vertical bone augmentation, the success of the implant and complications with other techniques for vertical alveolar bone reconstruction could help to clarify the results of this study.

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Table 1. Data from the patients included in the present study.

Patient	Gender	Site	Numbers of implants	Previous procedure	Mean vertical bone augmentation (mm)	Complication	Follow-up (months)	
1	MJC	F	12, 11, 21, 22	4	-	7.5	-	16
2	ICB	F	12, 11	2	-	3.0	-	36
3	EMS	F	12, 11, 21	3	Horizontal bone graft	4.2	-	72
4	DRDS	F	12, 11, 21, 22	4	Horizontal bone graft	5.5	-	27
5	PJP	M	11, 21	2	-	4.9	Loss of pulp vitality in 22	10
6	MLA	F	11, 21, 22	3	Horizontal bone graft	3.7	Implant apex was sectioned (site of 21)	54
7	JMM	F	13, 12, 11	3	Horizontal bone graft	3.4	01 implant was lost	24
8	RAE	F	11, 12	2	-	3.8	-	60
9	CDT	M	11, 21	2	-	8.4	Loss of pulp vitality in 12	6

Table 2. Frequency distributions of the papilla index scores in T1 and T3

Score	T1			T3		
	Implant-tooth	Implant-implant	Total*	Implant-tooth	Implant-implant	Total*
0	2	12	14	0	2	2
1	7	4	11	1	4	5
2	5	0	5	7	9	16
3	4	1	5	10	2	12
4	0	0	0	0	0	0

Score 0, no papilla formation; score 1, less than half of the papilla; score 2, at least half of the papilla is present; score 3, the papilla fills the whole interproximal space; score 4, abundance of papillae.

* $p > 0,001$ (Wilcoxon signed-rank test)

Table 3. Frequency scores of the satisfaction questionnaires concerning the appearance of the mucosa, discomfort, compliance and overall satisfaction.

	Score				
	0	1	2	3	4
Shape of the mucosa	-	3	-	3	3
Color of the mucosa	-	1	-	3	5
Discomfort	-	-	3	4	2
Compliance	-	-	2	1	6
Overall score	9.1				

Mucosa score: scale 0, completely dissatisfied; 1, dissatisfied; 2, neutral; 3, satisfied; 4, completely satisfied.

Discomfort: 1 = no discomfort; 2 = low discomfort; 3 = moderate discomfort; 4 = high discomfort.

Compliance: 1 = I would never undergo this procedure again; 2 = I would probably not undergo this procedure again; 3=I probably would undergo this procedure again; 4 = I would undergo this procedure again without any problems.

Overall score: scale 0, completely dissatisfied to score 10, completely satisfied.

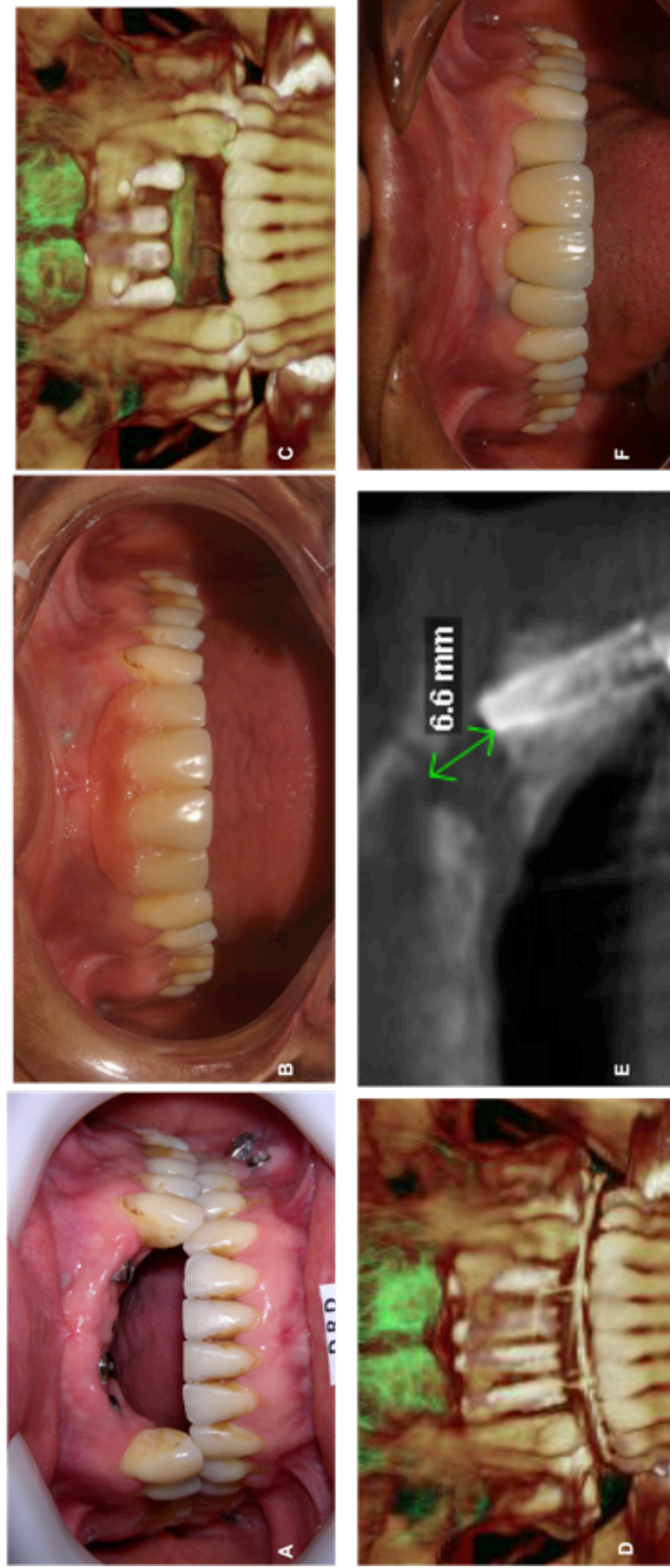


Figure 1. A 45-year old female patient presenting with alveolar vertical atrophy in the region of the maxillary incisors. A: The frontal intraoral view showing the vertical alveolar atrophy; B: The frontal view with a provisional prosthesis with artificial gingiva; C: A 3D reconstruction of a CBCT image showing four dental implants in the region of the maxillary incisors and an atrophied alveolar bone; D: A 3D CBCT reconstruction of the showing the repositioning of the bone-block segment; E: A sagittal slice of a CBCT image showing a bone gap of 6.6 mm after bone-block osteodistraction in the position of the maxillary right central incisor; F: The frontal intraoral view after installation of definitive crowns.

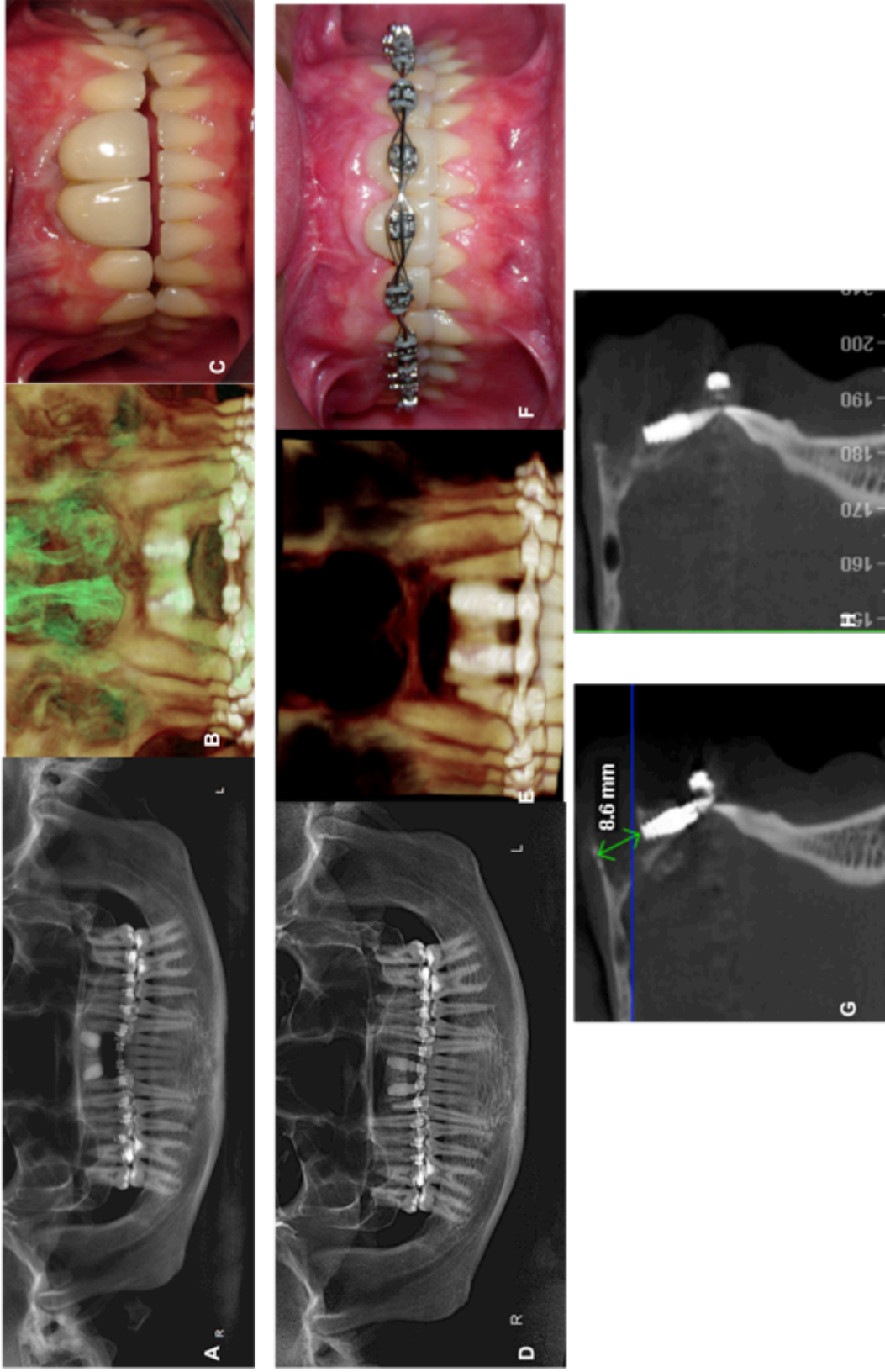


Figure 2. A 27-year-old male patient who underwent bone-block osteodistraction of the maxillary central incisors. A: The orthopantomogram x-ray after installation of the implants; B: A 3D CBCT reconstruction of the showing vertical alveolar bone atrophy at the site of the maxillary central incisors; C: The clinical frontal intraoral view showing the lack of papilla formation between the central incisors crowns and long crowns; D and E: The orthopantomogram x-ray and 3D CBCT reconstruction of the after implant-bone block osteodistraction. A gap is observed subapical to the implants, and the maxillary right lateral incisor was submitted to endodontic treatment due to loss of pulp vitality; F: The clinical frontal intraoral view 6 months postoperatively. A complete formation of papillae occurred between implants (score 3); G and H: A sagittal CBCT slice of the showing a bone gap of 8.6 mm at the site of the maxillary left central incisor implant and the bone formation in the gap 6-months postoperatively.

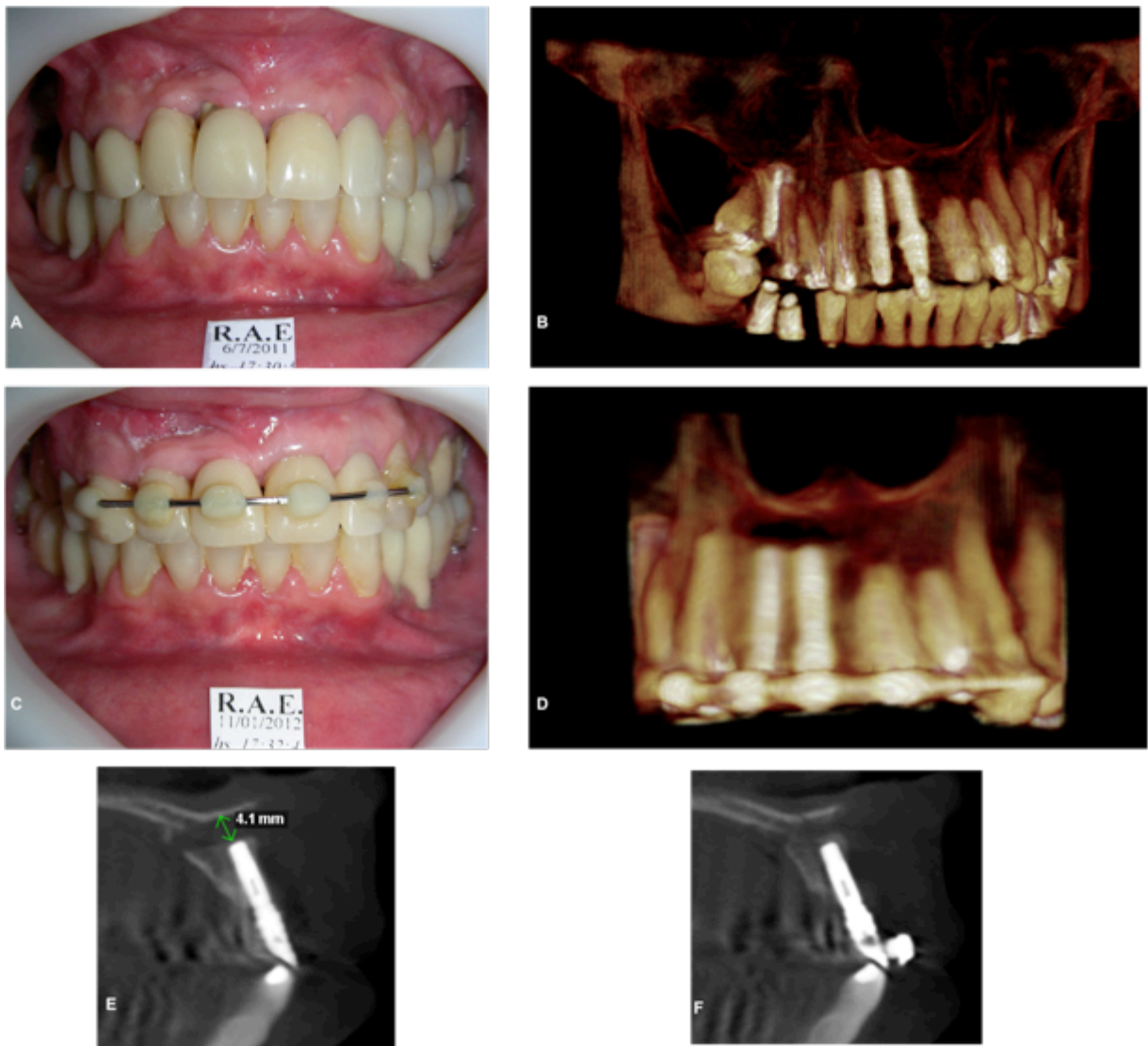


Figure 3: A 62-year-old female patient who underwent implant-bone block osteodistraction at the site of the maxillary right central and lateral incisors. A: The clinical frontal intraoral view showing the absence of papillae between the implant and an elongated lateral incisor; B: A 3D reconstruction of a CBCT image showing vertical alveolar bone atrophy at the site of the implants; C and D: The clinical frontal intraoral view and 3D CBCT reconstruction of the after bone-block osteodistraction showing partial formation of papillae between the implants and an improved length of the crowns; E and F: A sagittal slice from the site of the maxillary right incisor with a bone gap of 4.1 mm that was partially filled with new bone in T3.

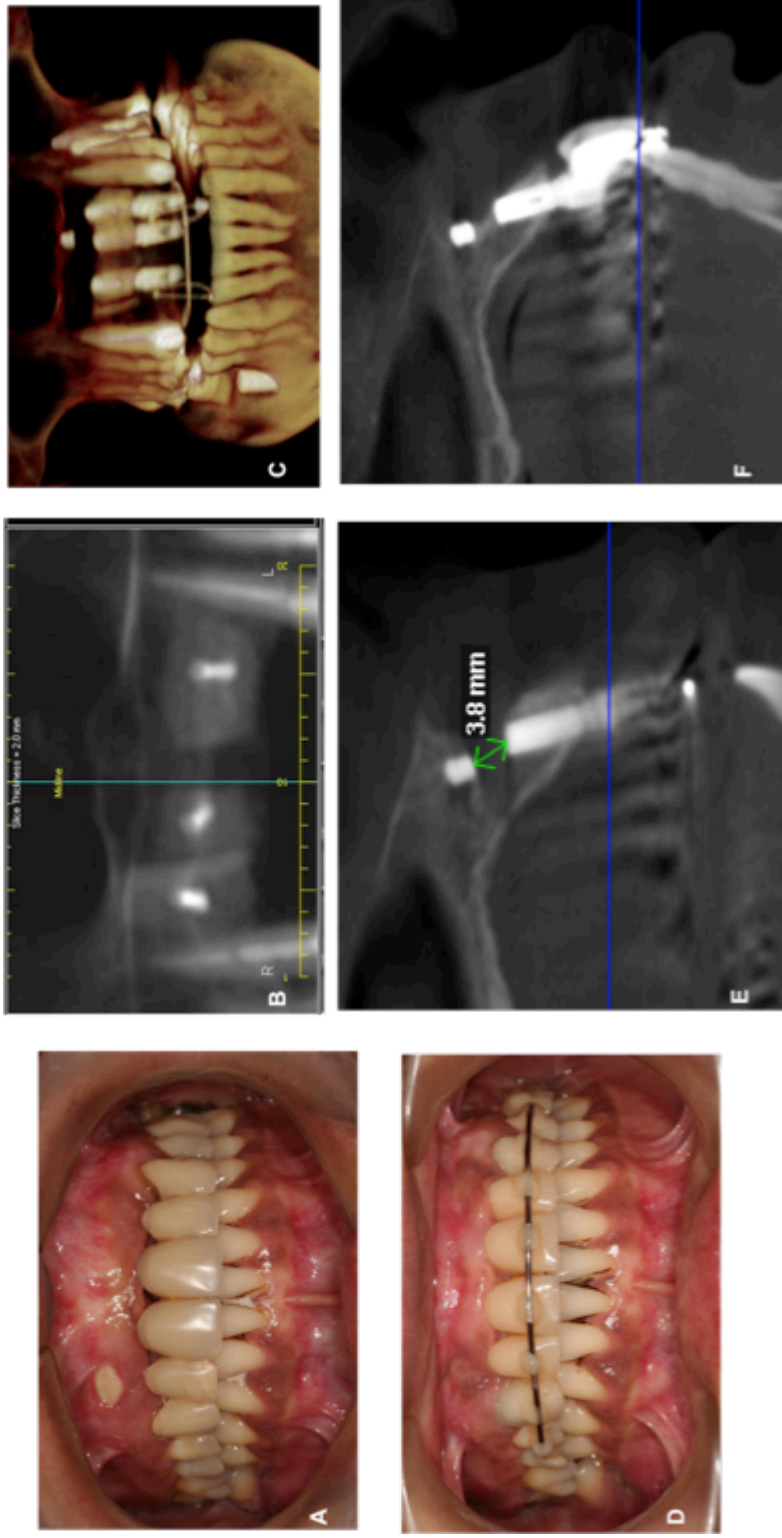
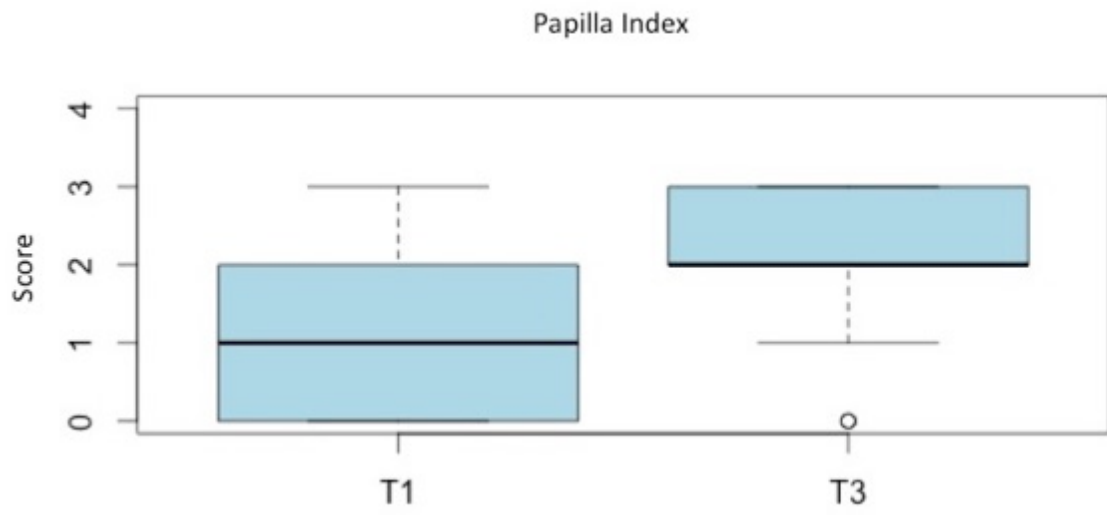


Figure 4: A 54-year-old female patient who underwent implant-bone block osteodistraction at the site of the maxillary central incisors and the left lateral incisor. A and B: The clinical frontal intraoral view and a coronal slice of a CBCT image after the horizontal bone graft. The graft at the site of the maxillary right lateral incisor was exposed in the oral cavity and removed, so it was not possible to insert the implant at this site. Vertical alveolar bone atrophy was also present in this region; C: A 3D reconstruction of a CBCT image after implant installation and bone-block osteodistraction. The apex of the implant at the site of the maxillary left central incisor was sectioned during the subapical osteotomy. D: The clinical frontal intraoral view at T3 showing partial formation of the papillae between the implants and esthetically favorable crowns. E and F: A sagittal slice of the CBCT image at the site of the maxillary left central incisor with a sectioned apex with a gap of 3.8 mm that was later filled with new bone.

Graphic 1. Distribution of the papilla index scores in T1 and T3.



4 CONCLUSÃO GERAL

Reabilitação oral em áreas de atrofia óssea alveolar vertical é complexa e representa um desafio clínico que é melhor tratado através de uma abordagem multidisciplinar. Embora diferentes opções de tratamento sejam propostos na literatura, a técnica apresentada neste estudo pode ser considerada como uma opção viável para a reconstrução de áreas com atrofia óssea alveolar vertical na região anterior da maxila, sem aumentar a perda do implante em um curto período de tempo. Além disso, o procedimento gera uma melhora significativa de estética gengival, sendo bem aceito pela maioria dos pacientes com um desconforto moderado. Dados prospectivos de ensaios clínicos, com um número maior de pacientes poderiam ajudar a complementar os achados deste estudo.

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APÊNDICE A – QUESTIONÁRIO APLICADO AOS PARTICIPANTES DA PESQUISA PARA AVALIAÇÃO DE SATISFAÇÃO, DESCONFORTO E ACEITABILIDADE DO TRATAMENTO

Nome: _____

Marcar “X” na resposta

1. QUAL O SEU GRAU DE SATISFAÇÃO GERAL COM O TRATAMENTO REALIZADO?

0	1	2	3	4	5	6	7	8	9	10

(Escala de 0 a 10, zero representa completamente insatisfeito, 10 completamente satisfeito)

2. COM RELAÇÃO À SUAS PRÓTESES DEFINITIVAS, MARQUE O GRAU DE SATISFAÇÃO PARA CADA UM DOS DOIS ITENS:

2.1. Forma das coroas (próteses):

0	1	2	3	4

(0: completamente insatisfeito; 1: insatisfeito; 2: Neutro; 3: Satisfeito; 4: Muito satisfeito)

2.2. Cor das coroas (prótese):

0	1	2	3	4

(0: completamente insatisfeito; 1: insatisfeito; 2: Neutro; 3: Satisfeito; 4: Muito satisfeito)

3. COM RELAÇÃO AOS TECIDOS MOLES (GENGIVA/MUCOSA) QUE CIRCUNDAM OS IMPLANTES, QUAL SEU GRAU DE SATISFAÇÃO COM:

3.1. Forma da mucosa/gengiva:

0	1	2	3	4

(0: completamente insatisfeito; 1: insatisfeito; 2: Neutro; 3: Satisfeito; 4: Muito satisfeito)

3.2. Cor da mucosa/gengiva

0	1	2	3	4

(0: completamente insatisfeito; 1: insatisfeito; 2: Neutro; 3: Satisfeito; 4: Muito satisfeito)

4. QUAL O GRAU DE DESCONFORTO DO PROCEDIMENTO?

Nenhum	Leve	Moderado	Severo

5. ACEITARIAM PASSAR NOVAMENTE PELO PROCEDIMENTO?

Sim	Talvez	Difícilmente	Não

ANEXO A – PARECER DO COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE FEDERAL DO
CEARÁ/ PROPESQ

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: AVALIAÇÃO RETROSPECTIVA DE OSTEOTOMIA EM BLOCO DO PROCESSO ALVEOLAR APÓS A INSTALAÇÃO DOS IMPLANTES

Pesquisador: Rafael Lima Verde Osterne

Área Temática:

Versão: 2

CAAE: 58778916.0.0000.5054

Instituição Proponente: Departamento de Clínica Odontológica

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.757.767

Apresentação do Projeto:

Trata-se de um estudo observacional e retrospectivo, que utiliza como amostra 11 pacientes que foram submetidos à reabilitação oral com implantes dentais, seguido de reposicionamento cirúrgico dos implantes e prótese sobre implante em uma clínica particular da cidade de Fortaleza. Todos os dados necessários, exceto os dados coletados por questionário, serão coletados através de dados do prontuário, tomografias computadorizadas e fotografias clínicas armazenadas na clínica. Os dados serão coletados em um único momento de três períodos diferentes, antes do reposicionamento do bloco ósseo (T1); imediatamente após a cirurgia de reposicionamento do bloco ósseo (T2); e após 6 meses da confecção da prótese definitiva (T3). Serão avaliados para o resultado do tratamento se houve ou não a perda de implantes envolvidos na movimentação e se a prótese final planejada pode ser instalada; e se ocorreram complicações que necessitem remoção da prótese/implante após carga inicial. Os dados avaliados serão: avaliação do aumento ósseo vertical, escore da papila (papilla index) e avaliação da satisfação do paciente (através de questionário).

Objetivo da Pesquisa:

Objetivo Primário:

Avaliar retrospectivamente resultado de aumento ósseo vertical, estética gengival e satisfação do

Endereço: Rua Cel. Nunes de Melo, 1000

Bairro: Rodolfo Teófilo

UF: CE

Município: FORTALEZA

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E-mail: comepe@ufc.br

UNIVERSIDADE FEDERAL DO
CEARÁ/ PROPESQ



Continuação do Parecer: 1.757.767

paciente após osteotomia em bloco do processo alveolar para reposicionamento de implantes dentários.

Objetivo Secundário:

Avaliar aumento ósseo vertical de processo alveolar após osteotomia em bloco do processo alveolar através de tomografia computadorizada.

Avaliar estabilidade do aumento ósseo vertical.

Avaliar resultado estético através de fotografias antes e após o tratamento.

Avaliar satisfação do paciente com o resultado final do tratamento.

Avaliação dos Riscos e Benefícios:

Riscos: Segundo os autores, o tipo de estudo a ser realizado apresenta um risco mínimo aos seus envolvidos, como a possibilidade de exposição de informações pessoais e uso inadequado de seus exames e resultados de exames. Entretanto, para evitar esse risco somente o pesquisador terá acesso aos dados de cada participante. Não é de interesse da pesquisa divulgar os dados individuais dos participantes, e sim os resultados gerais, esperados nos objetivos da pesquisa. Em nenhum momento da pesquisa os participantes serão identificados de forma individual.

Benefícios: Os autores informam que os benefícios esperados com a pesquisa são sobre os resultados clínicos e radiográficos do uso de reposicionamento cirúrgico de implantes dentais por osteotomias e mobilização do bloco ósseo.

Comentários e Considerações sobre a Pesquisa:

A pesquisa é pertinente considerando a importância da avaliação de uma opção terapêutica à casos com deficiência vertical de processo alveolar.

Considerações sobre os Termos de apresentação obrigatória:

Os termos de apresentação obrigatória foram apresentados e estão adequados.

Conclusões ou Pendências e Lista de Inadequações:

O projeto foi devidamente adequado após correção das pendências existentes, por isso proponho que o projeto deve ser aprovado.

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações	PB_INFORMAÇÕES_BÁSICAS_DO_P	22/08/2016		Aceito

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UF: CE **Município:** FORTALEZA
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Continuação do Parecer: 1.757.767

Básicas do Projeto	ETO_775994.pdf	11:41:09		Aceito
Outros	Respostaprojeto.pdf	22/08/2016 11:40:47	Rafael Lima Verde Osterne	Aceito
Declaração de Instituição e Infraestrutura	AUTORIZACAOfinal.pdf	22/08/2016 11:38:48	Rafael Lima Verde Osterne	Aceito
Projeto Detalhado / Brochura Investigador	projeto.comodificacoes.pdf	22/08/2016 11:37:33	Rafael Lima Verde Osterne	Aceito
Cronograma	CRONOGRAMAnovo.pdf	22/08/2016 11:36:07	Rafael Lima Verde Osterne	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLEFinal.docx	22/08/2016 11:35:51	Rafael Lima Verde Osterne	Aceito
Folha de Rosto	folhaderosto.pdf	16/08/2016 15:38:04	Rafael Lima Verde Osterne	Aceito
Outros	LattesRenato.pdf	15/08/2016 17:08:52	Rafael Lima Verde Osterne	Aceito
Outros	LattesRAFAEL.pdf	15/08/2016 17:08:07	Rafael Lima Verde Osterne	Aceito
Outros	CARTACEP MODELO FINAL.pdf	15/08/2016 17:03:14	Rafael Lima Verde Osterne	Aceito
Outros	TERMO_DE_COMPROMISSO_PARA_UTILIZACAO_DEfinal.pdf	15/08/2016 17:01:43	Rafael Lima Verde Osterne	Aceito
Orçamento	ORCAMENTO FINAL.pdf	15/08/2016 16:58:23	Rafael Lima Verde Osterne	Aceito
Cronograma	CRONOGRAMA_MODELOfinal.pdf	15/08/2016 16:57:05	Rafael Lima Verde Osterne	Aceito
Declaração de Pesquisadores	_DECLARACAO_PESQUISADORES_MODELOFINALfinal.pdf	15/08/2016 16:56:34	Rafael Lima Verde Osterne	Aceito

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

FORTALEZA, 03 de Outubro de 2016

Assinado por:
FERNANDO ANTONIO FROTA BEZERRA
(Coordenador)

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ANEXO B – TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO (TCLE)

Você está sendo convidado pelo pesquisador Rafael Lima Verde Osterne como participante da pesquisa intitulada “AVALIAÇÃO RETROSPECTIVA DE OSTEOTOMIA EM BLOCO DO PROCESSO ALVEOLAR APÓS A INSTALAÇÃO DOS IMPLANTES”. Você não deve participar contra a sua vontade. Leia atentamente as informações abaixo e faça qualquer pergunta que desejar, para que todos os procedimentos desta pesquisa sejam esclarecidos.

OBJETIVO: O objetivo que nos leva a estudar o problema é avaliar o resultado geral, estético e satisfação do paciente com o tratamento de reposicionamento de implantes através de osteotomias do processo alveolar.

PARTICIPAÇÃO NA PESQUISA: Ao participar desta pesquisa será aplicado o questionário, não identificado, e será necessário o preenchimento deste termo de consentimento livre e esclarecido.

Lembramos que os dados obtidos deste questionário será utilizado exclusivamente na presente pesquisa. A sua participação é voluntária, você tem a liberdade de não querer participar, e pode desistir, em qualquer momento, mesmo após ter iniciado a avaliação sem nenhum prejuízo para você.

RISCOS E DESCONFORTOS: O tipo de estudo a ser realizado apresenta um risco mínimo aos seus envolvidos, como a possibilidade de exposição de informações pessoais e uso inadequado de seus exames e resultados de exames. Entretanto, para evitar esse risco somente o pesquisador terá acesso aos dados de cada participante. Não é de interesse da pesquisa divulgar os dados individuais dos participantes, e sim os resultados gerais, esperados nos objetivos da pesquisa. Em nenhum momento da pesquisa os participantes serão identificados de forma individual.

BENEFÍCIOS: Os benefícios esperados com a pesquisa são sobre os resultados clínicos e radiográficos do uso de reposicionamento cirúrgico de implantes dentais por osteotomias e mobilização do bloco ósseo.

CONFIDENCIALIDADE: Todas as informações que o(a) Sr.(a) nos fornecer serão utilizadas somente para esta pesquisa. Suas respostas ficarão em segredo e o seu nome não aparecerá em nenhum lugar do questionário nem quando os resultados forem apresentados.

RESSARCIMENTO DAS DESPESAS: A participação no estudo não acarretará custos para você e não será disponível nenhuma compensação financeira adicional.

CONCORDÂNCIA NA PARTICIPAÇÃO: Se o(a) Sr.(a) estiver de acordo em participar deve preencher e assinar o Termo de Consentimento Pós-esclarecido que se segue, e receberá uma via deste Termo e a outra ficará com o pesquisador.

Lembramos que os dados obtidos deste questionário será utilizado exclusivamente na presente pesquisa. A sua participação é voluntária, você tem a liberdade de não querer participar, e pode desistir, em qualquer momento, mesmo após ter iniciado a avaliação sem nenhum prejuízo para você.

Garantimos que as informações conseguidas através da sua participação não permitirão a identificação da sua pessoa, exceto aos responsáveis pela pesquisa, e que a divulgação das mencionadas informações só será feita entre os profissionais estudiosos do assunto.

Endereço d(os, as) responsável(is) pela pesquisa:

Nome: Rafael Lima Verde Osterne
Instituição: Curso de Odontologia

Endereço: Rua Monsenhor Furtado, 1273, Rodolfo Teófilo, Fortaleza - CE Brasil

CEP 60430-355, Clínica 05, Curso de Odontologia
Telefones para contato: 999281718, 33668413

ATENÇÃO: Se você tiver alguma consideração ou dúvida, sobre a sua participação na pesquisa, entre em contato com o Comitê de Ética em Pesquisa da UFC/PROPESQ – Rua Coronel Nunes de Melo, 1000 - Rodolfo Teófilo, fone: 3366-8344. (Horário: 08:00-12:00 horas de segunda a sexta-feira).
 O CEP/UFC/PROPESQ é a instância da Universidade Federal do Ceará responsável pela avaliação e acompanhamento dos aspectos éticos de todas as pesquisas envolvendo seres humanos.

O abaixo assinado _____, ___anos, RG: _____, declara que é de livre e espontânea vontade que está como participante de uma pesquisa. Eu declaro que li cuidadosamente este Termo de Consentimento Livre e Esclarecido e que, após sua leitura, tive a oportunidade de fazer perguntas sobre o seu conteúdo, como também sobre a pesquisa, e recebi explicações que responderam por completo minhas dúvidas. E declaro, ainda, estar recebendo uma via assinada deste termo.

Fortaleza, ____/____/____

Nome do participante da pesquisa	Data	Assinatura
Nome do pesquisador	Data	Assinatura
Nome da testemunha (se o voluntário não souber ler)	Data	Assinatura
Nome do profissional que aplicou o TCLE	Data	Assinatura



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Renato Luiz Maia NOGUEIRA; Rafael Lima Verde OSTERNE; Ricardo Teixeira ABREU, Phelype Maia ARAÚJO

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Authors:

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