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Socket-shield Technique and immediate implant placement for ridge preservation in the aesthetic region: a 1-year clinical and tomographic follow-up

Técnica Socket-Shield e colocação imediata de implante para preservação do rebordo na região estética: acompanhamento clínico e tomográfico de 1 ano

Técnica de socket-shield y colocación inmediata de implantes para la preservación de la cresta en la región estética: seguimiento clínico y tomográfico de 1 año

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RESUMO

Objetivo: Descrever os aspectos clínicos, radiográficos e tomográficos, bem como complicações, sucesso, resultados estéticos e funcionais de um implante colocado pela técnica “socket shield”. **Detalhamento de Caso:** Representa um paciente de 46 anos, com aumento da mobilidade da coroa no sentido vestíbulo-palatino, com indicação de exodontia substituída por implante imediato. Extração atraumática, técnica de preservação do alvéolo e colocação imediata do implante foram realizadas. A técnica de soquete-escudo foi projetada para colocação de implantes para proteger o osso bucal e obter a estética adequada. O fragmento vestibular do dente foi mantido fixado e o implante foi colocado em contato com o fragmento dentário. A tomografia computadorizada Cone Bean mostrou formação óssea no aspecto vestibular 1 ano depois, e evidenciou estabilidade do tecido ósseo peri-implantar e substituição de remanescente radicular por osso. O aspecto clínico demonstrou manutenção dos tecidos moles peri-implantares e boa estética sem retração gengival. **Considerações finais:** O acompanhamento de um ano mostra cicatrização adequada e tecido peri-implantar saudável, sugerindo que a técnica soquete-shield com colocação imediata de implante pode ser uma alternativa de excelência para preservar a cortical vestibular e colocação de implantes, especialmente na área estética.

Palavras-chave: Prótese e Implante, Implantes Dentários, Carga Imediata em Implante Dentário, Gengival.

ABSTRACT

Objective: To describe the clinical, radiographic and tomographic aspects, as well as complications, success, aesthetic and functional results of an implant placed using the “socket shield” technique. **Case detail:** Represents a 46-year-old patient, with increased mobility of the crown in the bucco-palatal direction, with indication for extraction replaced by immediate implant. Atraumatic extraction, socket preservation technique and immediate implant placement were performed. The socket-shield technique was designed for placing implants to protect the oral bone and achieve adequate aesthetics. The buccal fragment of the tooth was kept fixed and the implant was placed in contact with the tooth fragment. Cone Bean computed tomography showed bone formation in the buccal aspect 1 year later, and demonstrated stability of the peri-implant bone tissue and replacement of the root remnant by bone. The clinical appearance demonstrated maintenance of peri-implant soft tissues and good aesthetics without gingival retraction. **Final considerations:** One-year follow-

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up shows adequate healing and healthy peri-implant tissue, suggesting that the socket-shield technique with immediate implant placement can be an excellent alternative for preserving the vestibular cortex and implant placement, especially in the aesthetic area.

Keywords: Prostheses and Implants, Dental Implants, Immediate Dental Implant Loading, Gingival.

RESUMEN

Objetivo: Describir los aspectos clínicos, radiográficos y tomográficos, así como las complicaciones, el éxito, los resultados estéticos y funcionales de un implante colocado mediante la técnica del “socket escudo”. **Detalles del Caso:** Representa un paciente de 46 años, con aumento de movilidad de la corona en dirección buco-palatina, con indicación de extracción sustituida por implante inmediato. Se realizó extracción atraumática, técnica de preservación del alvéolo y colocación inmediata del implante. La técnica socket-shield fue diseñada para la colocación de implantes para proteger el hueso bucal y lograr una estética adecuada. El fragmento bucal del diente se mantuvo fijo y el implante se colocó en contacto con el fragmento del diente. La tomografía computarizada de Cone Bean mostró formación ósea en la cara vestibular un año después y demostró estabilidad del tejido óseo periimplantario y reemplazo del remanente de la raíz con hueso. La apariencia clínica demostró el mantenimiento de los tejidos blandos periimplantarios y una buena estética sin retracción gingival. **Consideraciones finales:** El seguimiento al año muestra una cicatrización adecuada y tejido periimplantario sano, lo que sugiere que la técnica de socket-shield con colocación inmediata del implante puede ser una excelente alternativa para preservar la corteza vestibular y la colocación del implante, especialmente en el área estética.

Palabras clave: Prótesis e Implantes, Implantes Dentales, Carga Inmediata del Implante Dental, Gingival.

INTRODUCTION

Nowadays, dental implant therapy is a treatment option adopted as dental clinics’ routine. It is recommended for patients missing teeth due to its excellent prognosis and outcome. The greatest concern associated with patients who have lost a tooth in the anterior maxillary region, or who had it damaged due to trauma and/or fractures, lies on enabling successful osseointegration and its surrounding aesthetic gingival framework (WONG, et al., 2012).

A tooth extraction triggers a series of cellular events that end up remodeling both the bone tissue and its underlying soft tissues; this process leads to alveolar ridge resorption, which is mostly evident in the buccal bone plate (ARAÚJO MG e LINDHE J, 2005). This resorptive process is expected due to loss of vestibular blood supply deriving from the periodontal ligament, after tooth removal (TARNOW, et al., 2014).

Furthermore, buccal bone plate thickness in the anterior maxillary region is reported to be 1 mm, or lower, in almost 90% of patients who become more prone to surgical trauma and resorption processes (TARNOW DP, et al.,2014; BRAUT V, et al., 2011). In addition, this plate is mainly formed by cortical bone, without any vascular supply deriving from the endosteal marrow (TARNOW, et al., 2014).

Bone crest resorption has negative impact on implants’ position, as well as on implant prosthesis-emergence profile, besides leading to aesthetic results and biological complications, mainly in the anterior maxillary region (ALSHIDDI IF e DENT DC, 2015). Consequently, significant efforts have been made to preserve or limit physiological ridge remodeling processes after tooth extraction, such as adopting the socket maintenance technique based on using biomaterials for filling and biological barrier purposes (COOPER LF, et al., 2014).

Applying the dental implant-placement technique right after tooth extraction is the treatment of choice, since it helps maintaining gingival emergence profile and enables installing a provisional tooth right away, in a single surgical procedure, with high success rate (GHARPURE AS e BHATAVADEKAR NB, 2017). Dental implant placement with immediate loading after natural tooth extraction, whenever possible, guarantees mucosal architecture maintenance, as well as promotes long-term aesthetics and functionality. Among the main

advantages of adopting this technique, one finds reduced post-surgical bone resorption, minimal changes in gingival tissue architecture, shortened treatment time and increased patient satisfaction (CHRCANOVIC BR, et al., 2015).

However, when it comes to clinical practice, not all patients can undergo immediate dental implant placement with immediate loading and not all immediate implants are capable of maintaining the peri-implant soft and hard tissue framework, mainly in aesthetic regions showing minimal buccal bone plate thickness (CHEN ST e BUSER D, 2014).

Consequently, a previously introduced root submersion technique, which was applied - for the first time - to edentulous bone ridges in order to maintain denture support, was reassessed and used to preserve alveolar crests under fixed partial denture pontics (CASEY DM e LAUCIELLO FR, 1980; SALAMA M, et al., 2007). Hürzeler MB, et al. (2010) has introduced the “socket shield” technique based on the same concept of maintaining the periodontal ligament, the cementum and the alveolar bone. This technique lies on maintaining the buccal segment of the root to be extracted by mesio-distally sectioning the root and, subsequently, removing the palatine segment along with the apex and by maintaining the buccal segment to enable immediate implant placement in palatine position to the “shield” or vestibular root remnant (HÜRZELER MB, et al., 2010).

Taking in consideration the possible advantage of the socket shield technique in order to avoid buccal plate resorption in aesthetic region with a minimum bone thickness and its future application in implant dentistry, the aim of the current case report was to describe the clinical, radiographic and tomographic aspects, as well as complications, success, aesthetic and functional outcomes of a dental implant placed based on the “socket shield” technique, whose patient was subjected to 12-month follow-up after permanent crown placement.

CLINICAL CASE REPORT

This case report was approved by the Research Ethics Committee of the Faculty of Medicine of the Fluminense Federal University under submission number 5,682,361, referring to CAAE 61162822.9.0000.5243, in accordance with the principles of Resolution 466/2012. The participant signed an informed consent form, agreeing with the description of the report.

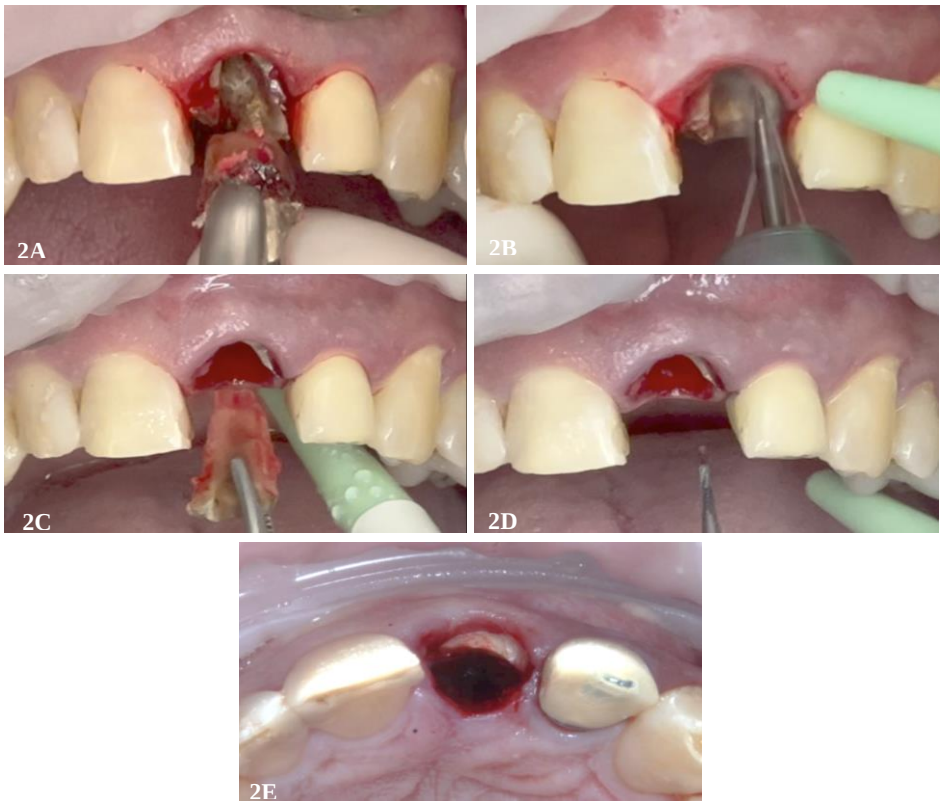
A 46-year-old male patient, H.V.S., came to the clinic reporting “wobbling tooth and pain when biting” in the upper central incisor. Increased crown mobility in the vestibular-palatine direction was observed during clinical examination which directed to two possible diagnoses: periodontitis or tooth fracture. The medical and familiar history showed no systemic disease, no medication uses or any genetic disease.

Patient had no history of previous intervention. Cone beam computer tomography was requested and results have shown a fracture line at cervical bone level, as well as periapical lesion (2.5 x 5 x 5 mm, in diameter) and type-1 root positioning, based on KAN JY, et al. (2011) classification (**Figura 1**). In addition to the clinical and radiographic examinations, blood tests, such as complete blood count, coagulogram and glycated hemoglobin, were requested to confirm no systemic contraindication to the surgical procedure.

This procedure was performed under local anesthesia, which comprised 4% Articaine added with epinephrine (at ratio of 1:100,000) applied to the mandible through infiltrating injection. Vestibular root reduction at bone level was performed after the fractured fragment was removed with extraction forceps n. 1 (**Figura 2**). It was followed by mesio-distal odontosection with the aid of long-shank 701 carbide drill (Figure 2B), which was also used to remove the palatine fragment and to maintain the vestibular barrier.

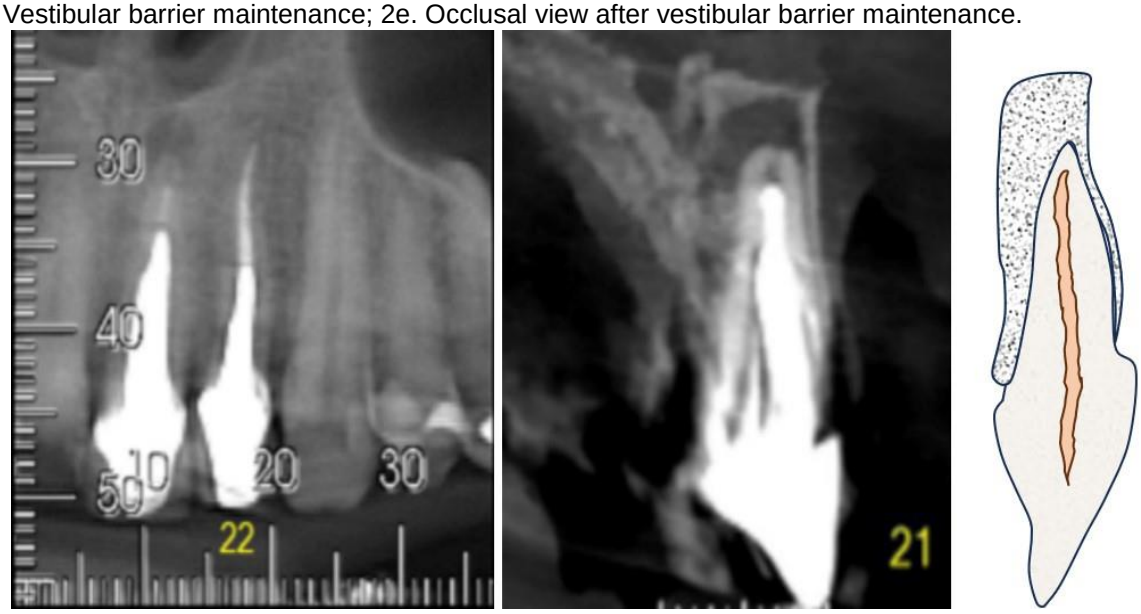
Bone milling and implant (EPIKUT Plus Cone Morse type, measuring 3.5mm x 13mm) placement were performed, based on the manufacturer’s specifications (ILCM 3513N – SIN- São Paulo – Brazil), until reaching 50-N torque. Immediate provisional prosthesis was manufactured based on using provisional titanium cylinder (CPTMU 3502-H – SIN – São Paulo – Brazil) and the gap between the implant and the vestibular remnant was filled with xenogeneic bone graft (Bio-Oss – Geistlich - São Paulo - Brazil) (**Figura 3**).

Figura 1 – Tomographic aspect of the upper right central incisor showing sagittal root position class I, based on KAN et al. (2011). The scheme on the right shows correlation between the buccal bone plate and the root of the upper central incisor. All schemas were created in the Microsoft Power Point 2010 Program.



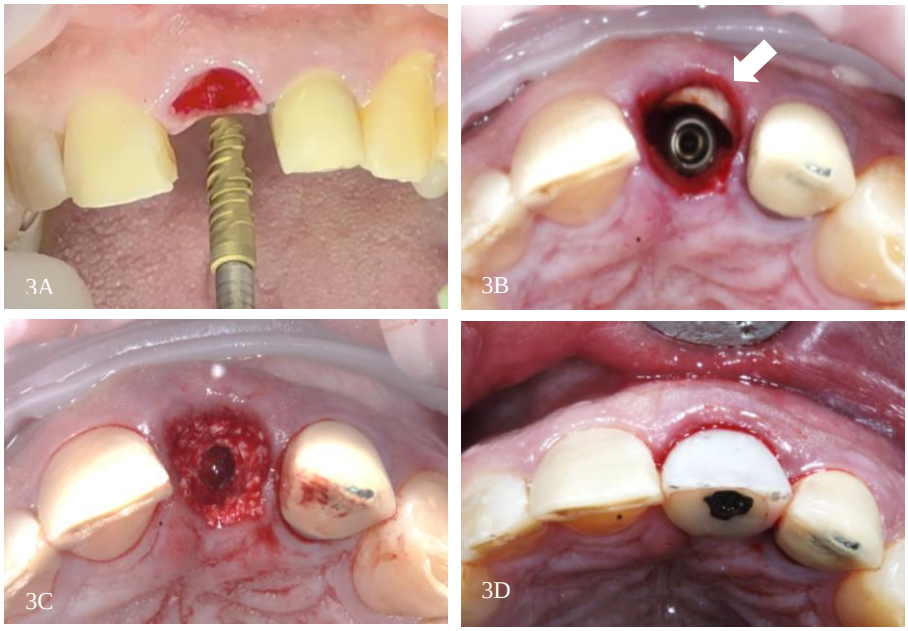
Fonte: Alvarenga M, et al., 2024.

Figura 2 – Primary surgical procedures used to perform the socket shield technique. 2a. Fractured fragment removal with extraction forceps n.1; 2b. Vestibular root reduction at bone level; 2c. Mesio-distal odontosection performed with the aid of carbide drill 701 and palatine fragment removal; 2D. Vestibular barrier maintenance; 2e. Occlusal view after vestibular barrier maintenance.



Fonte: Alvarenga M, et al., 2024.

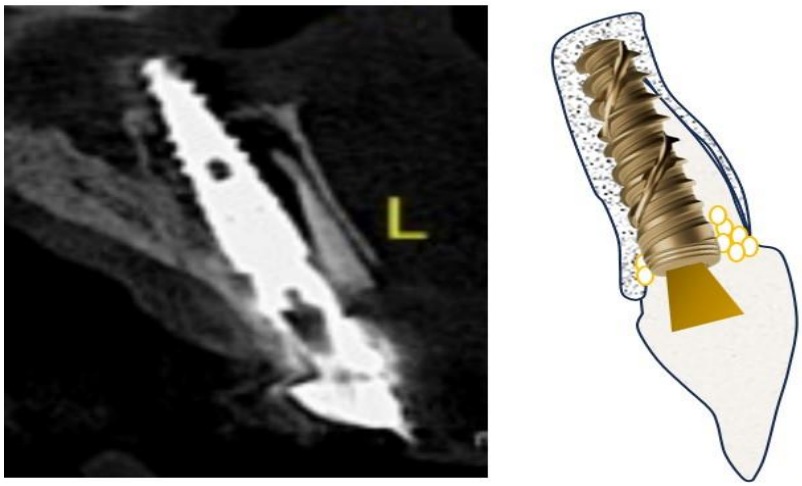
Figura 3 – Procedures adopted to place the implant and to manufacture the immediate provisional prosthesis. 3A. EPIKUT Plus Cone Morse implant (SIN – São Paulo – Brazil) placement in the palatine aspect of the bone remnant; 3B. Implant in place, with emphasis on the vestibular root remnant (arrow); 3C. Gap filling with xenogeneic graft; 3D. Immediate provisional prosthesis adaptation.



Fonte: Alvarenga M, et al., 2024.

Cone Bean computed tomography was requested right after the implant was placed. Results have shown implant's adequate three-dimensional positioning, as well as preservation of the buccal bone contour supported by the root remnant in this site (**Figura 4**). Chlorhexidine 0.12% was indicated twice daily for 14 days postoperatively.

Figua 4 – Tomographic aspect right after implant placement based on the socket shield technique. It is possible seeing both vestibular contour and root remnant stability. The diagram on the right shows correlation among the buccal bone plate, the vestibular root remnant of the upper central incisor and the placed implant. All schemas were created in the Microsoft Power Point 2010 Program.



Fonte: Alvarenga M, et al., 2024.

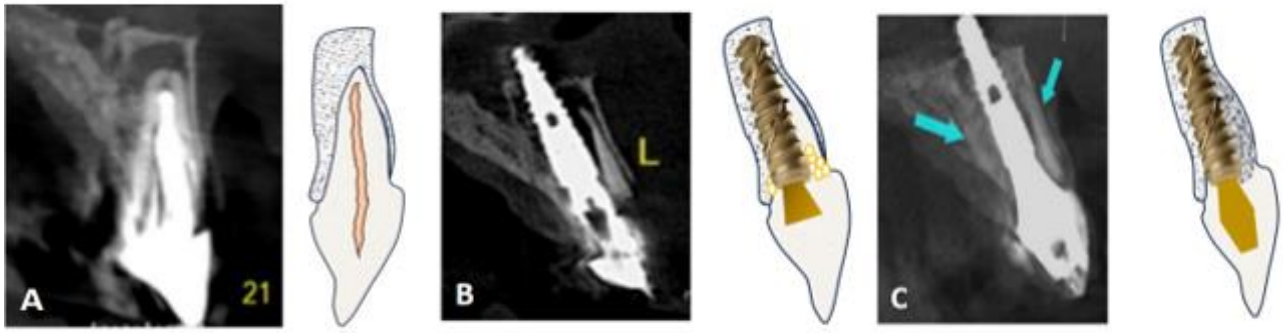
Ceramic crown was placed 3 months later by maintaining the volume of peri-implant soft and hard tissues to enable good aesthetics, with adequate gingival contour, in the rehabilitation process based on the soft shield technique. The clinical aspect has shown peri-implant soft tissue maintenance and good aesthetics without gingival retraction, 1 year later (**Figura 5**).

Figura 5 – A. Aesthetic clinical aspect 3 months after implant placement. B. Peri-implant soft tissue morphology showing stability and aesthetic contour, 1 year later.

Fonte: Alvarenga M, et al., 2024.

Cone Bean computed tomography has shown bone formation in the vestibular aspect 1 year later (**Figura 6**), and it has evidenced peri-implant bone tissue stability and root remnant replacement by bone. The patient was satisfied with the clinical result. In addition, the patient agreed with the proposed method from the beginning of the treatment, showing a positive reaction to the results achieved. No adverse events were observed.

Figura 6 – Comparison of remaining vestibular bone profile before tooth extraction (A) right after implant placement (B) and 1 year after socket shield technique application (C). It shows vestibular bone formation and implant stability (SIN – São Paulo - Brazil). All schemas were created in the Microsoft Power Point 2010 Program.



Fonte: Alvarenga M, et al., 2024.

DISCUSSION

Treatments based on delayed dental implant placement are well documented. They show high survival and success rates, as well as quite predictable outcomes. However, they often require longer time and multiple surgical procedures that, in most cases, can affect gingival contour stability in the aesthetic region (BUSER D, et al., 1997).

The current case report described the case of a patient subjected to implant placement right after tooth extraction in a region presenting low vestibular bone thickness. Option was made for performing odontosection and maintaining the vestibular root surface to avoid vestibular bone resorption, as well as future damage to peri-implant support tissue and aesthetics. Both clinical and tomographic results observed over 1 year based on the socket shield technique have evidenced successful rehabilitation without any complication type, as well as peri-implant soft and hard tissues showing stable aesthetic contour.

Implant placement right after tooth extractions started to be implemented to help reducing morbidity rates associated with several surgical interventions. This technique also presents high survival rates and better aesthetic outcomes than those observed for delayed implants. However, there may be complications capable of leading to tissue and bone volume loss around the implant and, therefore, capable of affecting the peri-implant soft tissue structure.

This issue is one of the major contraindications for this technique's application, mainly in regions presenting injured teeth, as well as lack of, or thin, vestibular plate (LANG NP, et al., 2012). The socket shield technique helps preserving vestibular contour by maintaining the tooth root's vestibular surface and by enabling immediate endosseous implant placement in the palatine aspect, as the one performed in the current case report.

Several studies conducted over the years reported stability of implant-based rehabilitation processes based on the socket shield technique. Prospective study conducted by Han CH, et al. (2020) with 30 patients assessed - over 2 years - the survival, stability and complications observed for implants placed through the socket shield technique (LANG NP, et al., 2012).

The aforementioned study reported lack of biological complications, as well as incidence of buccal bone plate conservation, in all cases. Habashneh RA, et al. (2019) conducted a case series study with 5 participants, after 1-year follow-up, and stated that the socket shield technique, together with immediate implant placement, is a minimally invasive protocol capable of preserving the contour of both hard and soft tissues and that it can be implemented in high aesthetic demand areas to achieve better outcome. Based on clinical and tomographic analyses, the current case report has evidenced buccal bone formation - over the course of 1 year - enough to support the aesthetic framework of the peri-implant soft tissue, as well as the functionality of the permanent implant prosthesis.

Root fragment preservation within proportions established by the adopted technique can guarantee the stability of the periodontal ligament inserted in the root cementum, whose tissue is lost in the remainder of the post-surgical socket. Histological studies recorded higher bone resorption rates in the palatine region than in the vestibular region, where the technique was recommended to be applied to and the ligament was maintained, as well as bone tissue formation between the remaining dentin layer and the dental implant (HAN CH, et al., 2018).

The tomographic aspect evidenced in the current case report, after 1 year, refers to bone tissue formation over the remaining root with nothing interposed between these tissues. This finding suggested new bone formation (around the implant) replacing the remaining tooth. Studies have also shown that vestibular root remnants subjected to the socket shield technique recorded quite low rejection rates and did not trigger inflammatory processes capable of posing risk to implant treatments (BÄUMER D, et al., 2017). These findings were confirmed in the current case report, which showed close contact between root remnant and implant, without any clinical adversity type or image.

Atieh MA, et al. (2021) conducted a systematic review comprising 7 clinical trials and 206 implants placed through the socket shield technique. They reported short-term positive effects on changes in buccal bone plate width and height, on peri-implant marginal levels and on aesthetic outcomes. Ogawa et al. conducted a systematic review comprising 20 studies and stated that the soft shield technique should be safely used to place endosseous implants, although it was necessary conducting long-term studies on this topic. The socket shield technique has shown encouraging clinical results in maintaining the original ridge morphology. Therefore, it can be used as alternative protocol for conventional immediate implant placement in the aesthetic zone (NGUYEN VG, et al., 2020).

However, although this technique does not virtually produce any change in hard and soft tissues' dimensions, and overall demands minimally invasive surgical interventions and shorter treatment time, it presents some limitations as shortage of consensus, evidence-based guidelines, large-scale clinical studies and long-term monitoring data. According to Lin et al., there is urgent need of conducting clinical studies in this field. Moreover, this technique requires high surgical skill level, since the preserved root section should be carefully handled to create the exact space necessary for the implant. This fact can increase the complexity of this procedure, which demands a steep learning curve, and it can lead to higher rates of complications, such as root fractures, infections and implant osseointegration issues (BÄUMER D, et al., 2017).

Buccal bone plate maintenance through the socket shield technique was the determining factor to guarantee stability of both bone and gingival tissues adjacent to the implant, as well as satisfactory aesthetic oral rehabilitation, in the present case report with tooth fracture in an aesthetic region with a minimum bone buccal plate. Therefore, we concluded that the socket shield technique appears to be a successful procedure when it is used in combination to immediate implant placement. The root fragment does not appear to interfere with the osseointegration process and it can have beneficial effects on implant aesthetics by protecting the vestibular bone from resorption processes.

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