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CASE SERIES

Oral soft tissue wound healing following the application of an oxygen-releasing gel: a case series

SÉRIE DE CASOS

Cicatrização de feridas em tecidos moles orais após a aplicação de um gel liberador de oxigênio: uma série de casos

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Keywords: Wound Healing; Oral Mucosa; Hydrogels; Oxygen; Bacterial Load; Soft Tissue Injuries.

Abstract

Oral soft tissue healing represents a clinical challenge due to continuous exposure to saliva, mechanical stress, and a complex microbial environment that may impair tissue repair. Novel therapeutic approaches aimed at optimizing local oxygen availability have emerged as promising adjuncts in wound management. This manuscript aims to evaluate the clinical outcomes of oral soft tissue wound healing following the topical application of an oxygen-releasing gel in different clinical scenarios involving oral mucosal injury. Patients presenting with oral soft tissue wounds of distinct etiologies were treated with a topical oxygen-releasing gel as an adjunctive therapy. The gel releases active oxygen upon contact with saliva, promoting angiogenesis and creating a favorable microenvironment for tissue regeneration while limiting anaerobic bacterial proliferation. Clinical healing outcomes were assessed based on tissue repair progression and postoperative recovery. Favorable healing responses were observed across all cases, with accelerated epithelialization, reduced inflammatory signs, and uneventful healing patterns. Based on the findings of this case series, we can conclude that the topical application of an oxygen-releasing gel showed promising clinical outcomes as an adjunctive approach for oral soft tissue wound management. Oxygen-delivering hydrogels may represent a biologically compatible and effective strategy to enhance tissue repair in oral clinical practice.

Palavras-chave: Cicatrização de Feridas; Mucosa Oral; Hidrogéis; Oxigênio; Carga Bacteriana; Lesões de Tecidos Moles.

Resumo

A cicatrização de tecidos moles orais representa um desafio clínico devido à exposição contínua à saliva, ao estresse mecânico e a um ambiente microbiano complexo que pode prejudicar o reparo tecidual. Novas abordagens terapêuticas voltadas para a otimização da disponibilidade local de oxigênio têm surgido como adjuvantes promissores no manejo de feridas. Este manuscrito tem como objetivo avaliar os desfechos clínicos da cicatrização de feridas em tecidos moles orais após a aplicação tópica de um gel liberador de oxigênio em diferentes cenários clínicos envolvendo lesões da mucosa oral. Pacientes que apresentavam feridas em tecidos moles orais de diferentes etiologias foram tratados com um gel tópico liberador de oxigênio como terapia adjuvante. O gel libera oxigênio ativo ao entrar em contato com a saliva, promovendo angiogênese e criando um microambiente favorável à regeneração tecidual, além de limitar a proliferação de bactérias anaeróbias. Os resultados clínicos da cicatrização foram avaliados com base na progressão do reparo tecidual e na recuperação pós-operatória. Respostas favoráveis de cicatrização foram observadas em todos os casos, com epitelização acelerada, redução dos sinais inflamatórios e padrões de cicatrização sem intercorrências. Com base nos achados desta série de casos, podemos concluir que a aplicação tópica de um gel liberador de oxigênio apresentou resultados clínicos promissores como abordagem adjuvante no manejo de feridas em tecidos moles orais. Hidrogéis liberadores de oxigênio podem representar uma estratégia biologicamente compatível e eficaz para potencializar o reparo tecidual na prática clínica odontológica.

Introducion

The oral mucosa serves as a critical protective barrier against mechanical stress, physical trauma, and microbial invasion. Following injury, oral tissues undergo a complex and dynamic sequence of biological events aimed at restoring structural integrity and functional homeostasis. Unlike cutaneous tissues, the oral mucosa exists within a constantly moist and warm environment exposed to saliva and a diverse microbial ecosystem, factors that may significantly influence wound healing outcomes[1,2]. Both local and systemic conditions play an essential role in determining the quality and predictability of tissue repair. Impaired healing may compromise the architectural integrity of oral tissues, potentially resulting in functional limitations and morphological alterations[3].

In clinical practice, haemostasis represents the initial and fundamental phase of wound healing, providing a stable environment for clot formation and subsequent tissue regeneration. Conventional approaches to postoperative bleeding control commonly involve the use of gauze or cotton compression to promote clot stabilization[4]. However, advances in biomaterial science have led to the development of modern wound dressings designed not only to achieve haemostasis but also to enhance tissue protection, improve patient comfort, prolong adhesion, and support biologically favorable healing conditions[4,5].

Currently, several intraoral wound management materials derived from synthetic and biological sources are available. Synthetic agents include hyaluronic acid formulations, chlorhexidine gels, cyanoacrylates, lipophilic polymer complexes, and oxygen-releasing topical gels, whereas biological materials are commonly obtained from plant or animal origins (Table 1).

Among these therapeutic approaches, hydrogels have attracted considerable attention due to their high-water content and structural similarity to the natural extracellular matrix. These hydrophilic polymer networks are capable of absorbing and retaining large amounts of water while maintaining structural stability, thereby recreating a hydrated microenvironment conducive to cellular migration, proliferation, and tissue regeneration [6, 7] additionally, hydrogels function as effective drug-delivery systems, enabling the controlled release of bioactive compounds that may enhance the wound healing process[3].

The application of functional hydrogels is particularly advantageous in the oral cavity, where constant saliva flow and functional movements often limit the retention of conventional topical agents. Oxygen-releasing hydrogels represent an emerging therapeutic strategy by improving local oxygen availability, supporting angiogenesis and cellular metabolism, while contributing to the control of anaerobic microbial proliferation[5].

Therefore, the present manuscript reports a case series describing the clinical application of a topical oxygen-releasing hydrogel (blue®m) in the management of oral and maxillofacial soft tissue wounds, aiming to illustrate its potential to enhance tissue healing while maintaining oral microbiome balance.

Table 1. Different gel formulations from various sources for intra-oral wound applications

Product	Properties/ mechanism	Type of wound	Remarks
Topical oxygen gel	Production of oxygen	Medication-related osteonecrosis of the jaw[5]	Recovery of the long standing osteonecrosis lesion
Hyaluronic acid (film or gel)	Linear polymer of glucuronic acid and N-acetylglucosamine disaccharide	Rat's tongue[6]	
		Extraction socket of patients with Uncontrolled Type II diabetes[7]	Better wound closure rate and wound healing scale
Chlorhexidine	0.2% concentration	Extraction socket[8]	Better wound closure and higher Landry wound healing index
Periacryl	n-butyl cyanoacrylate (fast setting) and 2-octyl cyanoacrylate (flexible)	Coronally advanced flap[9]	Better wound stability
		Palatal wound[10]	Faster epithelization
Adhesive - oral aid	An outer layer composed of lipophilic polymer complex; an inner layer, hydrophilic polymer complex; mucoadhesive layer, reacts with	Palatal graft donor site[11]	Reduce post-operative bleeding in the first 24 hours, reduce operative time

Case Series

Case 1

A 34-year-old Malay male patient was referred to the Periodontal Clinic with a chief complaint of gingival recession affecting the mandibular anterior teeth, primarily associated with aesthetic concerns and dentin hypersensitivity to dietary stimuli. The patient reported that the gingival recession became noticeable following orthodontic treatment performed to correct dental malalignment. Clinical examination revealed multiple facial gingival recession defects in the lower anterior region. Recession depth of approximately 3 mm was observed on teeth 33, 32, and 31, classified as RT2 defects, while tooth 41 presented 1.5 mm of recession (RT1). Teeth 42 and 43 demonstrated approximately 1 mm of recession, also classified as RT1 (Figure 1a). Root coverage surgery was performed using a tunnelling technique combined with a donor human dermal matrix graft to promote soft tissue augmentation and improve gingival thickness. Following flap stabilization and suturing, a topical oxygen-releasing gel (Blue®m) was applied immediately over the surgical site (Figure 1b). The patient was instructed to continue topical application twice daily for five days during the postoperative healing period. At the 5-day postoperative evaluation, sutures were removed, revealing favorable early wound healing characterized by adequate tissue adaptation, absence of inflammatory signs, and satisfactory soft tissue integration (Figure 1c). The surgical outcome resulted in improvement of gingival coverage, with resolution of hypersensitivity symptoms and satisfactory aesthetic enhancement.

Figure 1 - A 34-year-old male with multiple recession on lower anterior teeth (a). There is a combination of RT1 and RT2 recession defects on teeth 33 to 43. Recession coverage was done using donor dermal graft and the tunnelling technique (b). Blue®m gel was applied immediately post-op and the patient was instructed to apply the gel twice daily for 5 days. Sutures were removed at day 5 with very satisfactory healing (c).

Case 2

A 56-year-old female patient previously diagnosed with Generalized Periodontitis Stage IV, Grade B underwent successful Initial Cause-Related Therapy. Following periodontal stabilization, a localized residual deep periodontal pocket persisted at the mesial aspect of tooth 23, associated with an intrabony defect (Figure 2a). Periodontal regenerative surgery was indicated and performed using a Modified Minimally Invasive Surgical Technique (M-MIST) to preserve soft tissue integrity and enhance regenerative outcomes. The intrabony defect was treated with an alloplastic graft material (EthOss® biphasic synthetic graft), selected due to its complete resorption profile and handling characteristics. Primary wound closure was achieved using a single modified Laurell suture, followed by immediate application of a topical oxygen-releasing gel (Blue®m) over the surgical site (Figure 2b). The patient was instructed to apply the gel twice daily for five days during the early postoperative healing phase. At the 5-day postoperative visit, sutures were removed, demonstrating complete approximation of the surgical wound margins with favorable early healing and absence of inflammatory signs (Figure 2c). Clinical reassessment performed three months postoperatively revealed complete resolution of the periodontal pocket without additional gingival recession compared with baseline conditions. Radiographic evaluation demonstrated evident hard tissue fill consistent with regeneration of the intrabony defect.

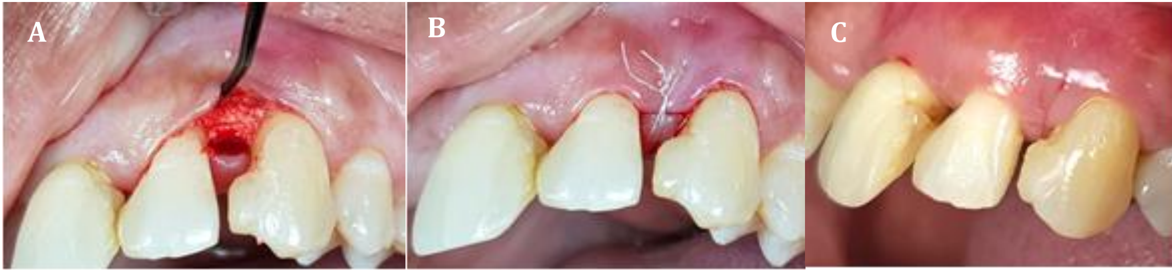

Figure 2 - In this second case, a 56-year-old female has periodontal intrabony defect on mesial of tooth 23 (a). Periodontal regenerative surgery was done with an alloplastic graft. Primary closure was achieved with a single modified Laurel suture and Blue®m gel applied immediately post-op (b). Patient was subsequently instructed to apply the gel twice daily for 5 days. Sutures were removed at day-5 and the surgical wound margins had completely approximated and healed (c).

Case 3

A 45-year-old male patient presented with an edentulous area at tooth site 46 indicated for dental implant placement (Figure 3a). Implant surgery was performed following standard surgical protocols. After implant insertion, primary wound closure was achieved using nylon sutures to ensure adequate soft tissue adaptation. Immediately after suturing, a topical oxygen-releasing gel (Blue®m) was applied to the surgical site (Figure 3b). The patient was instructed to apply the gel topically during the postoperative healing period according to the recommended protocol. At the 7-day postoperative evaluation, complete wound closure was observed with satisfactory soft tissue healing. Sutures were subsequently removed, demonstrating favorable tissue response without signs of inflammation or postoperative complications (Figure 3c).

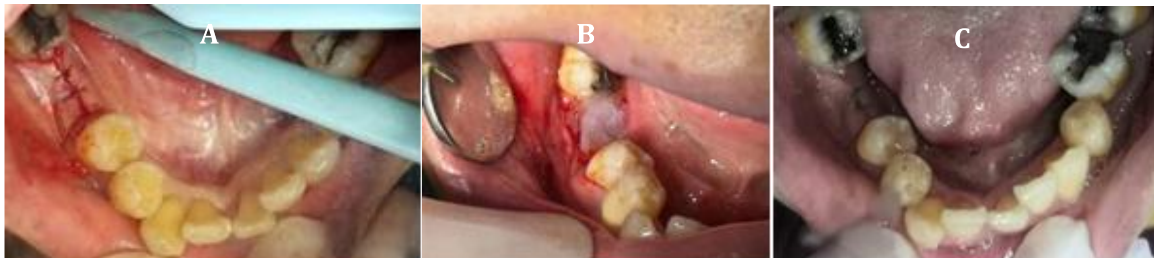

Figure 3 - This third case is a 45-year-old male with edentulous tooth 46 for implant placement (a). After implant surgery, the wound was closed primarily with nylon suture and the application of Blue®m gel (b). On post operative day 7, wound showed full closure and sutures removal was performed (c).

Case 4

A 43-year-old female patient presented with an edentulous area at tooth site 37 indicated for dental implant placement. Implant surgery was performed following conventional surgical protocols, and primary wound closure was achieved after implant installation. A topical oxygen-releasing gel (Blue®m) was applied directly over the sutured surgical site immediately after wound closure (Figure 4a). Approximately 10 minutes following application, a visible oxygen-releasing reaction was observed at the surgical area, indicating active oxygen delivery at the wound interface (Figure 4b). At the first postoperative day evaluation, the surgical site demonstrated favorable early healing characteristics, with adequate tissue adaptation and absence of inflammatory signs. At the first postoperative day evaluation, sutures were removed, and the surgical site demonstrated favorable early healing with satisfactory tissue adaptation and absence of inflammatory signs or postoperative complications (Figure 4c).

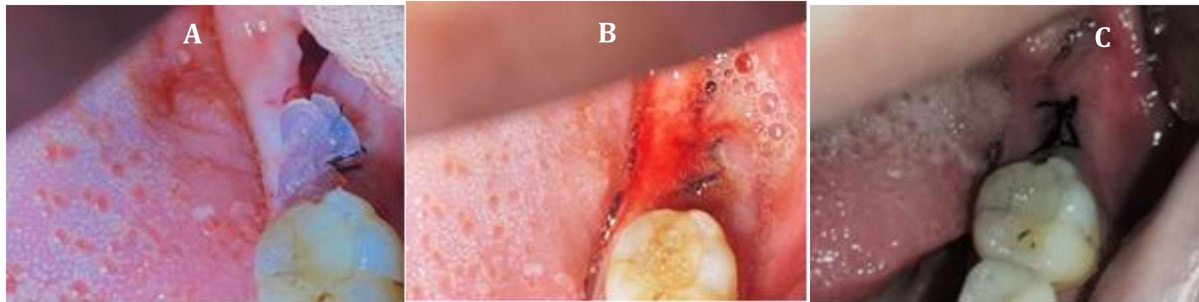

Figure 4 - Fourth case is a 43-year-old female with missing tooth 37 for implant placement. Application of Blue®m gel on the primary closure wound (a). The wound showed oxygen releasing effect after 10 minutes of Blue®m gel (b). On post operative day one, sutures removal was performed and wound appear good (c).

Case 5

A 26-year-old female patient presented with an edentulous area at tooth site 36 indicated for dental implant placement (Figure 5a). Implant surgery was performed according to conventional clinical protocols, followed by primary wound closure to ensure adequate soft tissue adaptation. After suturing, a topical oxygen-releasing gel (Blue®m) was applied over the surgical site and maintained in contact with the wound for approximately 10 minutes (Figure 5b). A visible oxygen-releasing reaction was observed, indicating active oxygen delivery at the wound surface. At the first postoperative day evaluation, the surgical site demonstrated satisfactory early healing, with proper tissue approximation and absence of clinical signs of inflammation or complications. Sutures were removed, and the wound exhibited favorable clinical appearance and stability (Figure 5c).

Figure 5 - This fifth case involves a 26-year-old female with missing tooth 36 for implant placement (a). Blue®m gel was placed on the primarily closed wound. The wound showed oxygen releasing effect after 10 minutes of Blue®m gel (b). On post operative day one, sutures removal performed and wound appeared good (c).

Case 6

A 27-year-old female patient, a breast cancer survivor with a previous history of chemotherapy, presented with hypodontia characterized by congenitally missing teeth 24, 25, and 35. Implant rehabilitation was planned, and the patient opted for implant placement. Implant surgery was performed at tooth site 35 following conventional surgical protocols. After implant placement, primary wound closure was achieved, and a topical oxygen-releasing gel (Blue®m) was applied over the sutured surgical site and maintained in contact with the wound for approximately 10 minutes to support early healing (Figure 6a). At the first postoperative day evaluation, the surgical wound demonstrated satisfactory tissue adaptation and favorable early healing characteristics (Figure 6b). During the same surgical session, autogenous bone grafting was performed for future implant rehabilitation at sites 24 and 25. Bone was harvested from the torus palatinus using a rotary bone harvester following a T-shaped incision, yielding approximately 0.5 cc of autogenous bone. The palatal donor site was treated with topical application of Blue®m gel (Figure 6c) and protected with a BloodSTOP® IX dressing to assist hemostasis and soft tissue stabilization (Figure

6d). At postoperative day one, the palatal donor site exhibited satisfactory granulation tissue formation, while the implant site at tooth 35 showed adequate wound stability and absence of inflammatory signs. Sutures were removed, demonstrating uneventful healing at both surgical areas (Figure 6e).

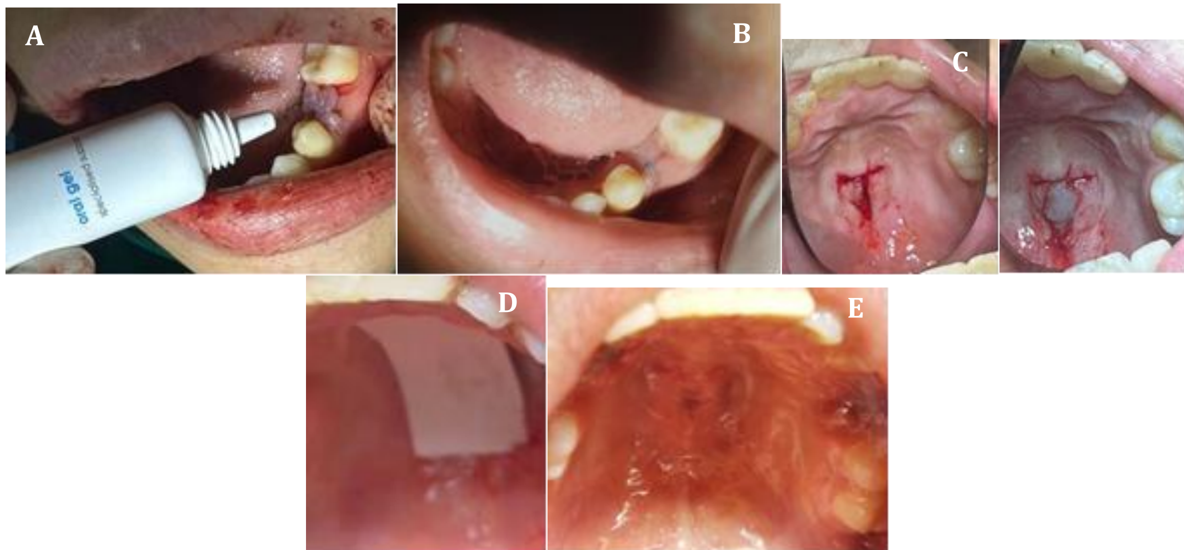

Figure 6 - This sixth case is a 27-year-old female breast cancer survivor with a history of chemotherapy. She presented with missing tooth 35 for implant placement (a,b). Implant surgery was performed with autograft harvested from torus palatinus. Application of Blue®m gel and Bloodstop IX was done over the palatal donor site (c,d). Blue®m gel also applied on the surgical site of 35. On postoperative day one, palatal wound was well granulated and the wound over tooth 35 showed good healing (e).

Discussion

Oxygen-delivering hydrogels have recently emerged as a promising adjunctive approach for wound management in oral and maxillofacial surgery. The oral cavity represents a challenging healing environment due to continuous microbial exposure, saliva contamination, and mechanical stress, factors known to influence wound stability and tissue repair outcomes[1,2]. Enhancement of local oxygen availability has therefore been proposed as a biologically driven strategy to improve healing conditions in oral tissues[5,8].

The present case series demonstrated favorable clinical healing outcomes following adjunctive application of a topical oxygen-releasing hydrogel across different surgical indications, including mucogingival surgery, periodontal regeneration, implant placement, and procedures involving autogenous graft harvesting. Early wound stability and satisfactory tissue adaptation were consistently observed in all presented cases, allowing early suture removal without clinical signs of inflammation or wound dehiscence. Similar clinical benefits associated with topical oxygen therapy have been previously described in periodontal and implant-related surgical procedures[11].

The positive healing responses observed may be explained by the essential role of oxygen in the physiological stages of wound healing. Adequate oxygen tension is required for oxidative phosphorylation and ATP production, which directly support fibroblast proliferation, epithelial migration, and tissue repair.[8] Oxygen also plays a critical role in collagen synthesis through hydroxylation of proline and lysine residues, a process necessary for stabilization of the collagen triple helix and extracellular matrix formation[8].

Additionally, sustained oxygen delivery has been shown to stimulate angiogenesis via upregulation of vascular endothelial growth factor (VEGF), promoting neovascularization and improving nutrient diffusion within regenerating tissues[9]. Improved oxygenation may accelerate transition from the inflammatory phase toward proliferative and remodeling stages of healing, contributing to faster clinical recovery.

Beyond its regenerative effects, oxygen availability influences microbial homeostasis. Increased oxygen tension inhibits the proliferation of anaerobic periodontal pathogens such as Porphyromonas gingivalis and Tannerella forsythia, microorganisms strongly associated with periodontal and peri-implant disease progression[10]. Furthermore, oxygen enhances

neutrophil and macrophage oxidative killing mechanisms, improving host immune response during early wound healing.

The oxygen-releasing hydrogel used in this case series contains sodium perborate, glucose oxidase, xylitol, and lactoferrin. Upon contact with tissue fluids, these components generate controlled low concentrations of hydrogen peroxide, enabling gradual oxygen release while maintaining biocompatibility. Previous investigations have demonstrated that lactoferrin contributes to angiogenesis modulation and collagen fiber formation while exerting antimicrobial activity, supporting favorable healing conditions[8].

Recent clinical observations reported by Leventis et al.(2024)[11] described successful use of topical oxygen gel therapy in periodontal defects, peri-implant diseases, guided bone regeneration complications, and surgical wound management following cyst removal[11]. Likewise, active oxygen therapy has been reported in the treatment of medication-related osteonecrosis of the jaw (MRONJ), achieving complete epithelialization after failure of conventional treatment modalities[5]. These findings support the growing evidence that oxygen-based topical therapies and controlled oxygen-delivery biomaterials may enhance healing outcomes in complex oral surgical scenarios[11–14]. In addition, hydrogen peroxide–based adjunctive antimicrobial approaches and oxygen-carrier hydrogels have also demonstrated beneficial effects in periodontal therapy and tissue engineering[12,13].

Despite the encouraging clinical observations, the inherent limitations of a case series design, including lack of control groups and quantitative outcome measurements, must be acknowledged. Future randomized controlled clinical trials are necessary to validate the clinical effectiveness of oxygen-releasing hydrogels and to establish standardized protocols for their application in oral and periodontal surgery.

Conclusion

Based on the clinical observations presented in this case series, the adjunctive use of a topical oxygen-releasing hydrogel demonstrated favorable outcomes in oral soft tissue wound management across different surgical indications, including mucogingival surgery, periodontal regeneration, implant placement, and procedures involving autogenous graft harvesting. Consistent early wound stability, satisfactory tissue approximation, and uneventful postoperative healing were observed in all cases, including in a medically compromised patient. The sustained release of oxygen may contribute to enhanced angiogenesis, collagen synthesis, microbial control, and improved local tissue metabolism, thereby supporting physiological wound healing processes within the challenging oral environment.

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RELATO DE CASO

Tratamento da mordida aberta anterior com intrusão de molares utilizando ancoragem esquelética: relato de caso

CASE REPORT

Treatment of anterior open bite with molar intrusion using skeletal anchorage: a case report

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Resumo

A mordida aberta anterior (MAA) é uma má oclusão caracterizada pela sobremordida negativa. O presente trabalho tem como objetivo relatar um caso de tratamento de MAA por meio da intrusão de molares superiores utilizando ancoragem esquelética. A paciente do sexo feminino, 25 anos, foi encaminhada para tratamento ortodôntico devido à queixa principal de recidiva da MAA. No exame extraoral, foram observados retrognatismo mandibular com selamento labial passivo. No exame intraoral, constatou-se apinhamento dos incisivos superiores, ausência dos primeiros pré-molares superiores, molares em relação Classe II de Angle bilateralmente, enquanto os caninos apresentaram relação Classe I no lado esquerdo e Classe II no lado direito e interposição lingual. Para o alinhamento e nivelamento dos arcos dentários foram utilizados bráquetes autoligados passivos estéticos. Para a intrusão dos molares superiores foram inicialmente instalados mini-implantes palatinos e miniplacas vestibulares, que foram substituídas por mini-implantes vestibulares após 6 meses de tratamento. Na fase final do tratamento foram empregados elásticos intermaxilares nos caninos superiores e nos caninos e primeiros pré-molares inferiores para o assentamento da oclusão. O tratamento foi concluído após 23 meses alcançando o fechamento da MAA, com uma sobremordida de 2mm, e correção de alinhamento dentário. Os molares permaneceram em Classe II e foi obtida a relação de Classe I nos caninos. Casos de MAA representam grande desafio para a Ortodontia, dependendo de um diagnóstico preciso e manejo adequado da biomecânica. Concluiu-se, portanto, que o tratamento foi finalizado com êxito devido ao correto diagnóstico, aplicação adequada dos princípios biomecânicos e colaboração do paciente.

Palavras-chave: Mordida Aberta; Má Oclusão; Técnicas de Movimentação Dentária; Ortodontia

Abstract

Anterior open bite (AOB) is a malocclusion characterized by a negative overbite. The present study aims to report a case of AOB treatment through maxillary molar intrusion using skeletal anchorage. A 25-year-old female patient was referred for orthodontic treatment due to the chief complaint of AOB relapse. Extraoral examination revealed mandibular retrognathism with passive lip seal. Intraoral examination showed crowding of the maxillary incisors, absence of the maxillary first premolars, bilateral Angle Class II molar relationship, while the canines presented a Class I relationship on the left side and Class II on the right side, along with tongue interposition. Passive self-ligating esthetic brackets were used for dental alignment and leveling of the arches. For maxillary molar intrusion, palatal mini-implants and buccal miniplates were initially installed, which were replaced by buccal mini-implants after 6 months of treatment. In the final phase of treatment, intermaxillary elastics were used on the maxillary canines and on the mandibular canines and first premolars to achieve occlusal settling. Treatment was completed after 23 months, resulting in closure of the AOB, a 2 mm overbite, and correction of dental alignment. The molars remained in Class II relationship, and a Class I canine relationship was achieved. AOB cases represent a major challenge in Orthodontics, depending on accurate diagnosis and proper biomechanical management. It was therefore concluded that the treatment was successfully completed due to correct diagnosis, appropriate application of biomechanical principles, and patient compliance.

Keywords: Open Bite; Malocclusion; Tooth Movement Techniques; Orthodontics

Introdução

A mordida aberta anterior (MAA) possui várias definições na literatura, entretanto, a que melhor explica a condição descreve como uma má oclusão caracterizada pela falta de contato entre dentes superiores e inferiores[1,2] em relação cêntrica[3,4,5], podendo ocorrer na Classe I, II ou III de Angle[6,7]. Outra definição encontrada retrata a MAA como a ausência de sobremordida[8].

A etiologia da mordida aberta pode ser classificada em causas esqueléticas e dentárias. Essas características anatômicas são parcialmente determinadas pela genética e influenciadas pelo ambiente, ou seja, por fatores comportamentais[9,2]. Entretanto, embora a genética pareça estar correlacionada com as dimensões craniofaciais, o ambiente se mostra mais influente nas variações das arcadas, principalmente quando há presença de hábitos com grande magnitude ou grande duração de força[10].

Em relação aos fatores comportamentais, durante a dentição decídua vários hábitos podem influenciar a mordida aberta, entretanto, as evidências sugerem que esses hábitos não tenham poder negativo no crescimento até os três anos de idade[11,12,13,14, 15]. Após a erupção dos dentes permanentes, com a perpetuação desses hábitos, as chances do desenvolvimento da mordida aberta anterior aumentam[10,16,17], chegando a dobrar a prevalência quando envolve a sucção[6].

Segundo alguns autores, outro fator relacionado à mordida aberta anterior é a posição da língua[18]. Desde bebê, o ser humano possui o hábito de empurrar a língua para frente ao deglutir a fim de criar um selamento fisiológico[10]. Ao realizar esse movimento repetidas vezes durante um longo período, acredita-se que pode causar a abertura da mordida[11,13,14,19]. Em contrapartida, outros autores afirmam que não é possível definir essa situação como causa ou resultado, pois, apenas uma parcela das crianças que realizam o movimento desenvolve a má oclusão[18,20,21]. Além das alterações posturais da língua, a posição da cabeça e da mandíbula também podem influenciar a situação. A postura de cabeça mais posterior com a maxila girando em sentido anti-horário prejudica sua a relação com a mandíbula, permitindo a supra erupção dos molares[10].

Outra situação que pode estar ligada ao desenvolvimento da MAA é a respiração bucal decorrente da obstrução das vias nasais[6,20], inchaço alérgico e outros bloqueios anatômicos[22] que podem levar a um padrão de crescimento hiper divergente e desenvolvimento da mordida aberta[16], entretanto, a minoria dos respiradores bucais apresenta esta condição[10].

Para a correção da mordida aberta anterior existem diversas intervenções terapêuticas, sendo essencial um diagnóstico preciso para a definição da opção de tratamento mais adequada. As terapias disponíveis incluem abordagens cirúrgicas e não cirúrgicas, combinadas com mioterapia e controle de hábitos deletérios, bem como correção ortodôntica[22,24,25]. As intervenções ortodônticas podem envolver a extrusão de incisivos e/ou a intrusão de molares, com ou sem ancoragem esquelética temporária, utilizando miniplacas e mini-implantes[23,24,26].

A ancoragem esquelética com miniplacas e mini-implantes revolucionou o tratamento de diversos problemas esqueléticos, anteriormente corrigidos principalmente com cirurgia ortognática. Os efeitos benéficos desse procedimento são atribuídos à autorrotação da mandíbula no sentido anti-horário, que contribui para a redução das alturas faciais do esqueleto e dos tecidos moles, aumento da projeção do mento, redução da sobressalência e incremento da sobre mordida, além de alterar a posição do lábio inferior[23, 25].

A intrusão de molares é recomendada para pacientes com mordida aberta, que, entre ouras características, apresentam altura molar aumentada. A intrusão dos dentes posteriores ou anteriores é frequentemente difícil de ser alcançada sem causar a extrusão dos dentes de ancoragem. A utilização da ancoragem esquelética oferece uma solução eficaz para este problema. Por exemplo, a intrusão dos dentes posteriores é crucial na correção da mordida aberta, e relatos de casos demonstram que o uso de miniplacas pode resultar na intrusão dos molares superiores e inferiores em 3 a 5 mm, enquanto promove a rotação mandibular no sentido anti-horário[27,28].

Diante do exposto, o presente trabalho tem como objetivo relatar um caso clínico de tratamento da mordida aberta anterior através da intrusão de molares com ancoragem esquelética. A paciente em questão autorizou a utilização das imagens e das informações do caso por meio da assinatura de Termo de Consentimento Livre e Esclarecido para este fim.

Relato de caso

Diagnóstico

A paciente APK, gênero feminino, 25 anos e 10 meses de idade, buscou tratamento ortodôntico com a queixa principal de mordida aberta anterior. A paciente foi encaminhada para o tratamento ortodôntico por um especialista em desordem temporomandibular e dor orofacial para estabilização oclusal, após o tratamento dos sinais e sintomas de disfunção temporomandibular.

Foi relatado histórico de tratamento ortodôntico prévio com aparelhos fixos, incluindo as extrações dos primeiros pré-molares superiores. De

acordo com o relato da paciente, a mordida aberta anterior surgiu após o término do tratamento.

No plano frontal, a análise facial revelou uma boa proporção entre os terços superior, médio e inferior, além de relação simétrica entre os lados direito e esquerdo e mento centralizado na face. A proporção entre o comprimento do lábio superior e inferior era de 1:2, com selamento labial passivo. No plano lateral, foi observado retrognatismo mandibular, característico de pacientes Classe II de Angle (Figura 1).

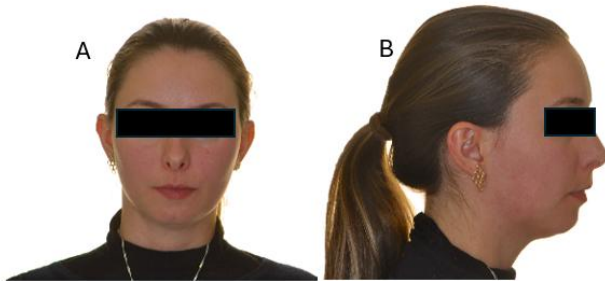

Figura 1 - A: Fotografia inicial frontal demonstrando boa proporção entre os terços da face e simetria entre lados esquerdo e direito. B: Fotografia inicial lateral demonstrando retrognatismo mandibular.

Na análise do sorriso, observou-se a exposição de apenas aproximadamente metade das coroas dos incisivos centrais superiores, caracterizando um sorriso baixo. As coroas dos incisivos inferiores também estavam parcialmente visíveis. A linha do sorriso era consoante em relação à curvatura do lábio inferior e era possível observar interposição da língua lingual entre os arcos dentários na região anterior (Figura 2).

Figura 2: Fotografia do sorriso inicial demonstrando sorriso baixo e interposição lingual entre os arcos na região anterior.

A análise da dentição mostrou que o arco dentário inferior apresentava uma boa forma e que os dentes inferiores estavam bem alinhados. Havia contenção fixa nas faces linguais de caninos e incisivos inferiores. O arco dentário superior apresentava um bom alinhamento, porém, com leve apinhamento nos incisivos centrais e laterais, além das ausências dos primeiros pré-molares.

Na relação interarcos foi observada relação molar de Classe II bilateral, devido às extrações de pré-molares realizadas no tratamento ortodôntico prévio. Os caninos apresentavam relação de Classe I no lado esquerdo e de Classe II de 3mm no lado direito. As linhas médias superiores e inferiores estavam coincidentes. A mordida aberta anterior caracterizada pela ausência de contato entre os dentes superiores e inferiores, estava presente desde o segundo pré-molar superior direito até o segundo pré-molar superior esquerdo, com uma distância de 3mm entre as bordas incisais dos incisivos centrais superiores e inferiores. O nível de higiene bucal era muito bom e a paciente apresentava recessões gengivais no canino superior direito e nos pré-molares inferiores (Figura 3).

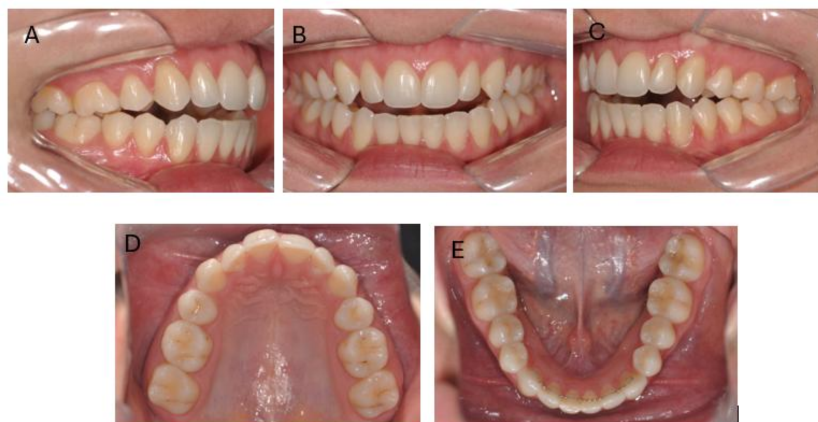

Figura 3: Fotografias intrabucais iniciais evidenciando mordida aberta anterior, relação molar de Classe II bilateral e caninos em relação de Classe I no lado esquerdo e de Classe II no lado direito. A: Vista lateral direita B: Vista frontal C: Vista lateral esquerda D: Vista oclusal arcada superior E: Vista oclusal arcada inferior.

A radiografia panorâmica mostrou que os primeiros molares superiores e o canino inferior direito apresentavam angulação distal e os incisivos centrais inferiores apresentavam inclinação mesial das raízes. Os terceiros molares e os primeiros pré-molares superiores estavam ausentes (Figura 4).

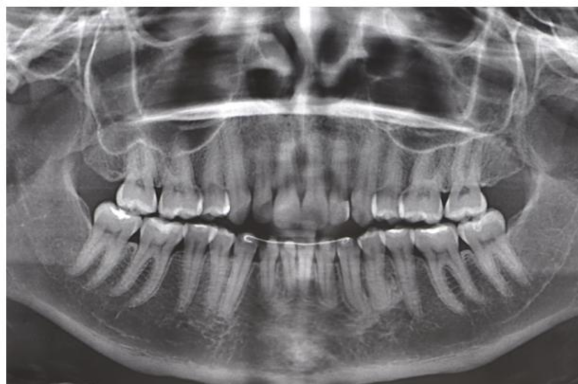

Figura 4: Radiografia panorâmica inicial indicando que os primeiros molares superiores e o canino inferior direito apresentavam angulação distal e os incisivos centrais inferiores apresentavam inclinação mesial das raízes.

Na análise cefalométrica inicial foi observado que a maxila apresentava uma pequena retrusão e que a mandíbula estava acentuadamente repruída em relação à base anterior do crânio (SNA=78º; SNA=71,5º). Os incisivos superiores estavam inclinados para lingual e os inferiores para vestibular (1.NA=18,7º; IMPA= 103º; 1.NA=37º). O padrão facial apresentava uma tendência de crescimento vertical (FMA= 33,5º; SN-GoMe=41,8º; Eixo Y=74,8º) com perfil facial convexo (H. NB=13,7º) – (Figura 5 e Tabela 1).

Tabela 1: Análise cefalométrica inicial.

Variável	Norma	Início
SNA (º)	82	78
SNB (º)	80	71,5
ANB (º)	2	6,5
FMA (º)	25	33,5
SN-GoMe (º)	32	41,8
Eixo Y (º)	67	74,8
1.NA (º)	22	18,7
1-NA (mm)	4	2,0
1.NB (º)	25	37,0
1-NB (mm)	4	8,0
IMPA (º)	90	103,8
Âng. Interincisal (º)	131	117,8
H. NB (º)	10,5	13,7

Fonte: Autores

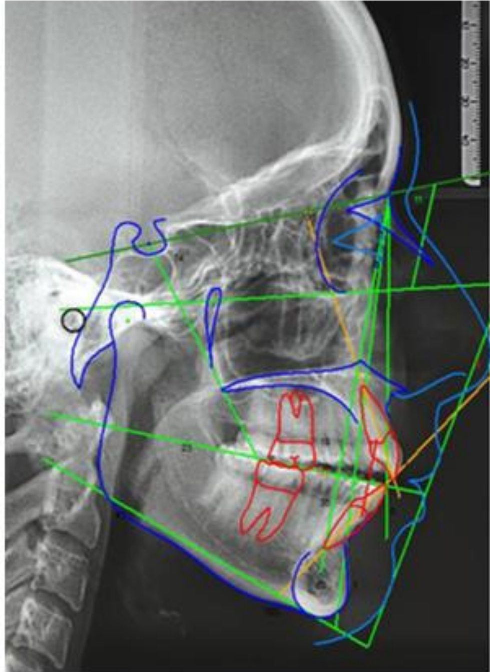

Figura 5: Telerradiografia de perfil com traçado cefalométrico inicial, onde pode ser observado que, sagitalmente, a maxila apresentava uma pequena retrusão e que a mandíbula estava acentuadamente retruída em relação à base anterior do crânio.

Antes do tratamento ortodôntico a paciente apresentava dor temporomandibular associada a quadro e osteoartrite das ATM, com alterações degenerativas moderadas a avançadas para a idade. A estabilização prévia do quadro de dor e o controle da progressão da osteoartrite foi importante para estabilização mandibular e consequente aumento da previsibilidade do tratamento ortodôntico, uma vez que a degeneração progressiva dos côndilos pode causar recidiva da má oclusão (Figura 6).

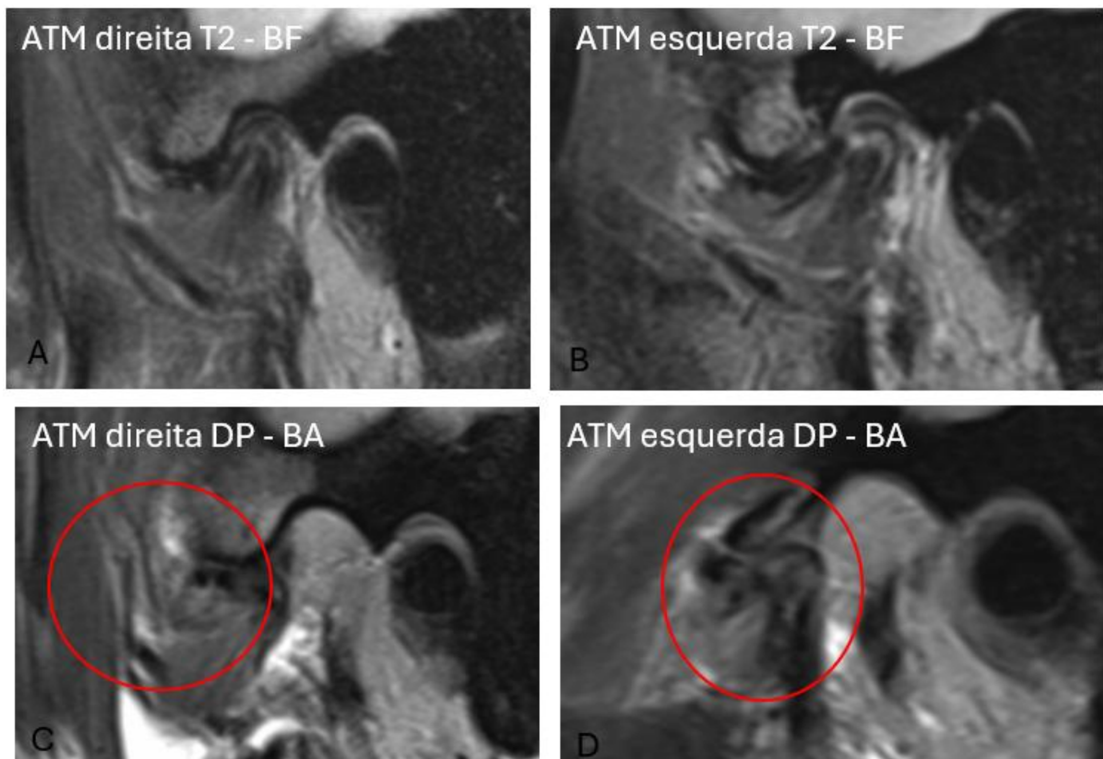

Figura 6: Osteoartrite das ATM com alterações degenerativas moderadas a avançadas. A/B: Ressonância magnética de ATM direita e esquerda com boca fechada C/D: Ressonância magnética de ATM direita e esquerda com boca aberta.

O diagnóstico final foi definido como má oclusão de Classe II por deficiência mandibular com mordida aberta anterior e rotação horária da mandíbula.

Plano de Tratamento

Após o diagnóstico foram propostas as seguintes metas para o tratamento ortodôntico: 1 – alinhamento e nivelamento dos arcos dentários; 2 – Intrusão dos molares superiores com mini - implantes e miniplacas para produzir a rotação anti-horária da mandíbula com o objetivo de fechar a mordida; 3 – Estabilização da oclusão; 4 – Adequação da forma dos arcos dentários e 5 – Obtenção das guias funcionais.

Alternativas de Tratamento

Como alternativa de tratamento, foi proposto o tratamento ortodôntico associado à cirurgia ortognática. A opção de tratamento eleita pela paciente foi a apresentada no plano de tratamento.

Biomecânica

Para o alinhamento e nivelamento dos arcos dentários foram utilizados bráquetes autoligados passivos estéticos com prescrição MBT 0.022” (TrueKlear, Forestandent).

A intrusão dos molares superiores foi iniciada instalando-se mini-implantes no palato nos lados direito e esquerdo, na direção dos pontos de contato entre os primeiros e segundos molares. O movimento de intrusão foi iniciado pelo lado palatino pois havia contatos oclusais mais fortes nas cúspides palatinas dos molares superiores (Figura 7).

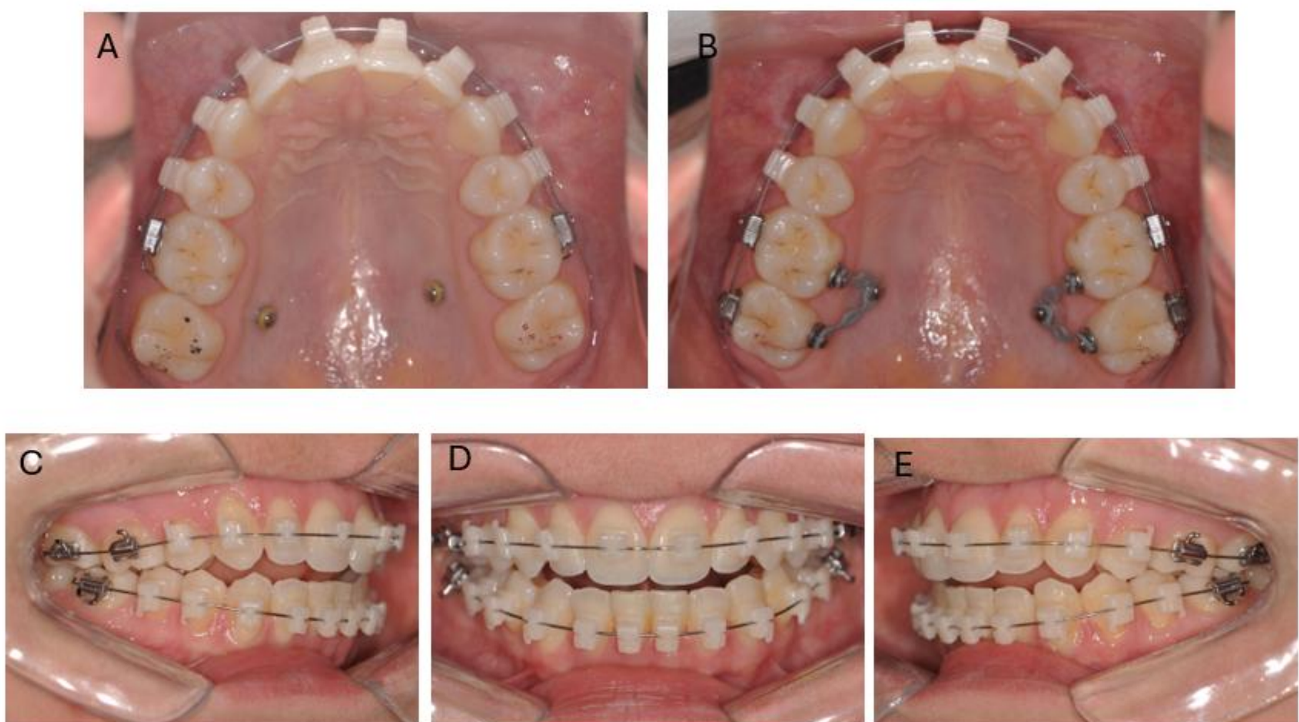

Figura 7: - A intrusão dos molares superiores foi iniciada. A: Instalação dos mini-implantes no palato B: Aplicação de força sobre os mini-implantes C: Aparelho ortodôntico fixo instalados vista lateral direita D: Aparelho ortodôntico fixo instalados vista frontal. E: Aparelho ortodôntico fixo instalado,vista lateral esquerda.

Posteriormente, após o ajuste inicial da inclinação vestibulolingual dos molares superiores foram instaladas miniplacas vestibulares para aplicação de força por vestibular e lingual, para produzir uma resultante passando pelo centro de resistência dos molares superiores, e produzir intrusão absoluta, sem inclinação (Figuras 8, 9 e 10).

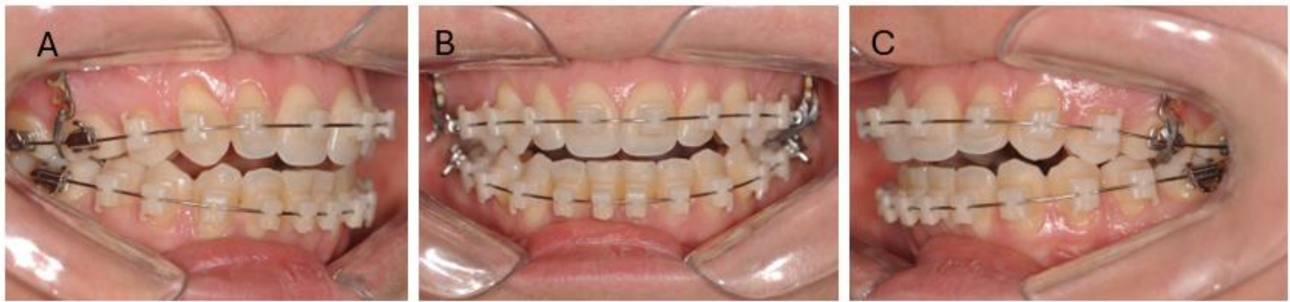

Figura 8 - A: Miniplacas instaladas na região vestibular lado direito B: Vista frontal C: Miniplacas instaladas na região vestibular lado esquerdo.

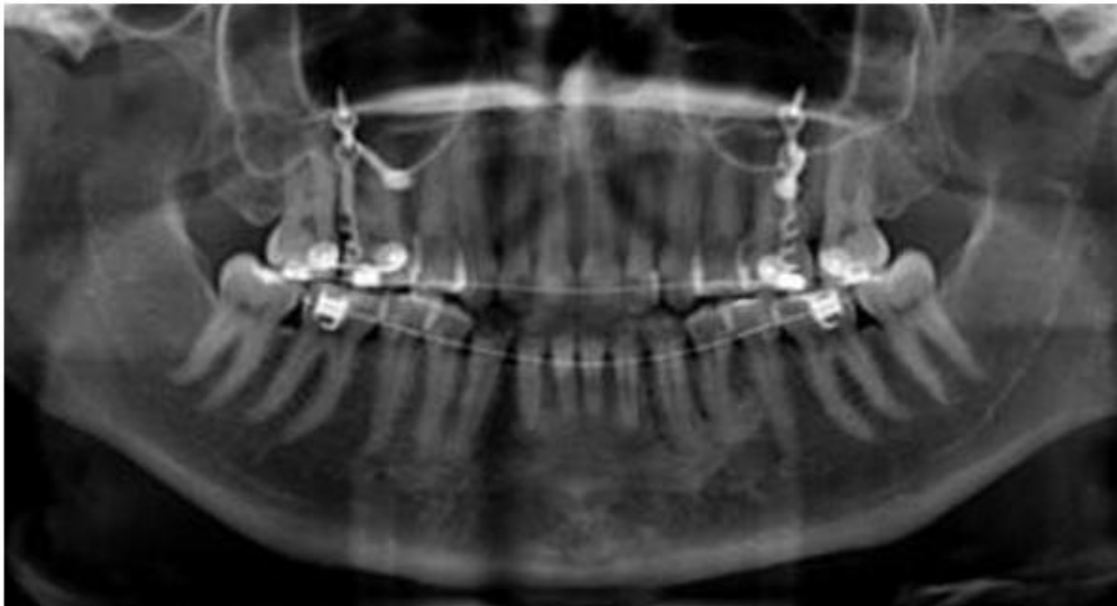
Figura 9: Radiografia panorâmica após instalação de miniplacas vestibulares e mini- implantes palatinos.

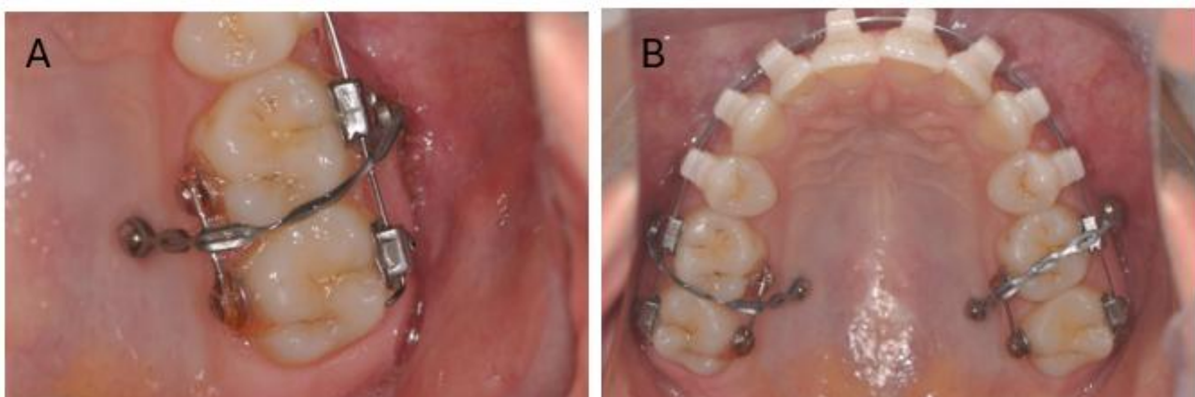

Figura 10: A/B Aplicação de força no sentido vestibulolingual.

Foram utilizados botões linguais conectados com segmentos de fio de aço 0,8mm para estabilizar as correntes elásticas sobre as faces oclusais dos molares superiores.

Progresso do caso

A paciente permaneceu com esse sistema por 6 meses alcançando uma rotação mandibular anti-horária que proporcionou o fechamento inicial da mordida, obtendo-se o trespasse vertical de 1mm (Figura 11).

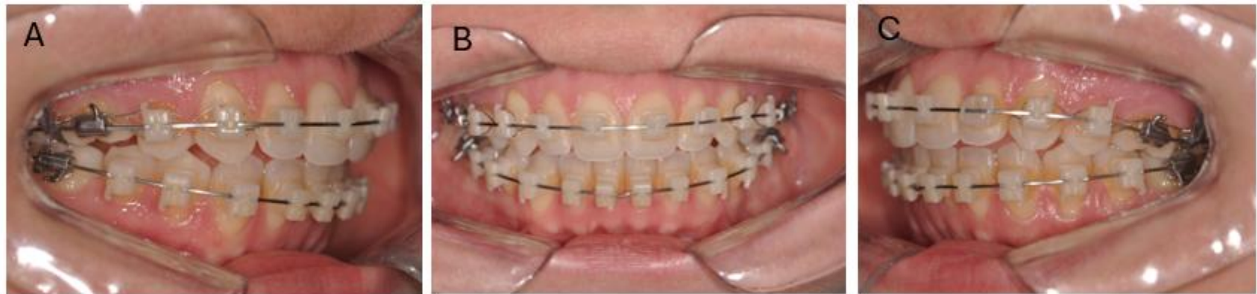

Figura 11: Evolução após 6 meses de tratamento alcançando uma rotação mandibular anti-horária que proporcionou o fechamento inicial da mordida, obtendo-se o trespasse vertical de 1mm. A: Vista lateral direita B: Vista frontal C: Vista lateral esquerda.

Entretanto, durante o tratamento ocorreu a inflamação na região das miniplacas vestibulares e estas foram substituídas por mini- implantes (Figura 12).

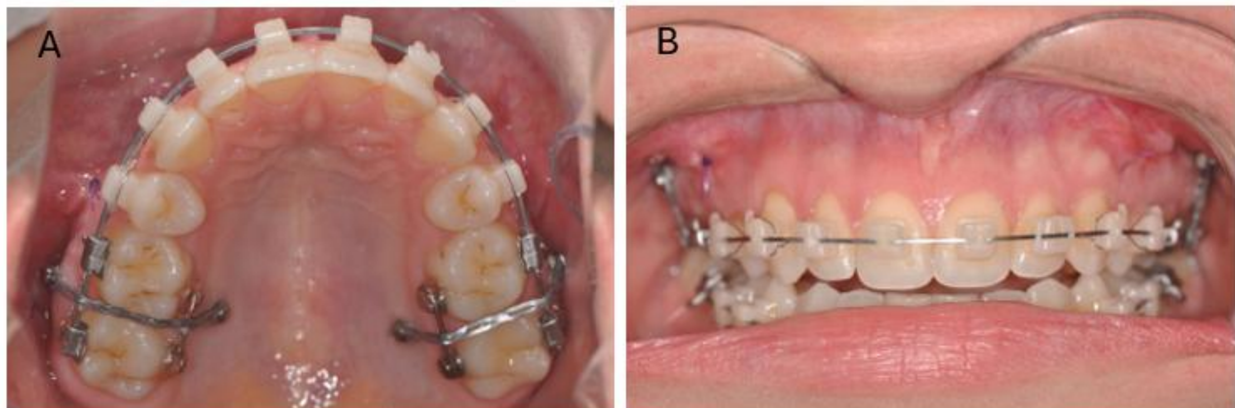

Figura 12: A: Vista oclusal após substituição de miniplacas vestibulares por mini-implantes devido à inflamação B: Vista frontal após substituição de miniplacas por mini-implantes.

Na fase final do tratamento foram utilizados elásticos intermaxilares 3/16” médios triangulares em caninos superiores e caninos e primeiros pré-molares inferiores para assentamento da oclusão (Figura 13).

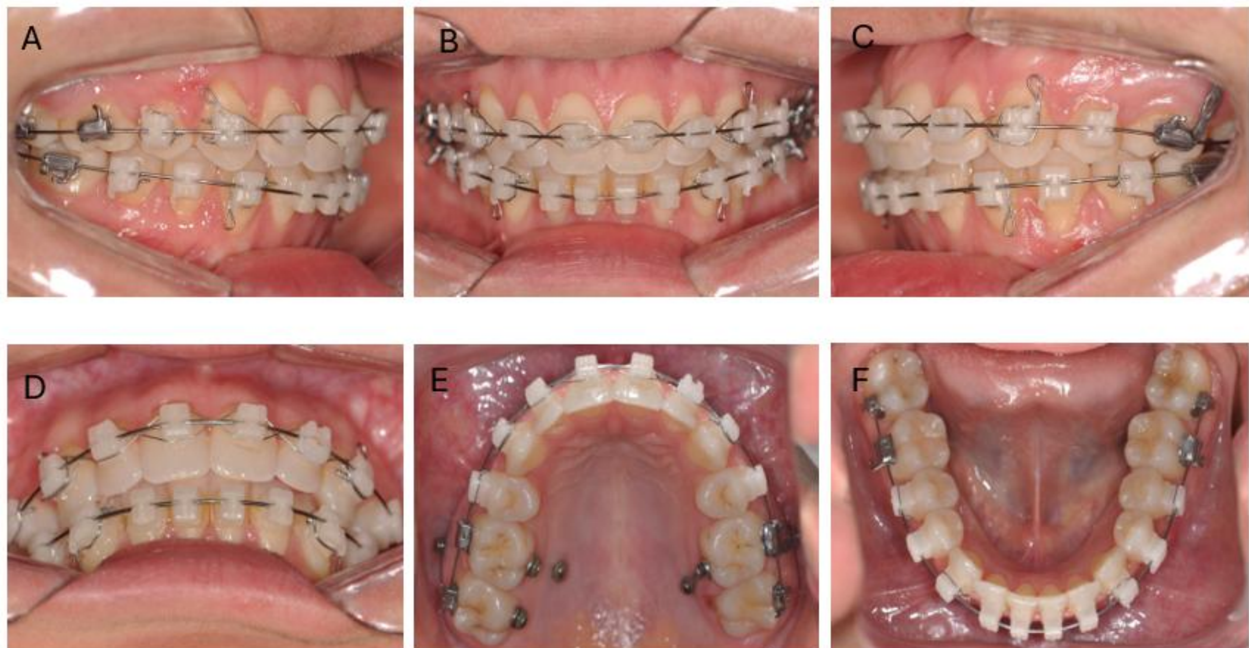

Figura 13: Fase de finalização do tratamento ortodôntico com elásticos intermaxilares para assentamento da oclusão. A: Vista lateral direita B: Vista frontal C: Vista lateral esquerda D: Dentes em oclusão E: Vista oclusal arcada superior F: Vista oclusal arcada inferior.

Resultados do Tratamento

A paciente completou o tratamento de forma satisfatória, concluindo-o ao longo de um período de 23 meses. Em relação aos resultados do tratamento, não existiram alterações faciais significativas, como era esperado (Figura 14). No sorriso, ocorreu o fechamento da mordida aberta anterior com uma melhora significativa da exposição dos incisivos superiores e manutenção da linha do sorriso consoante (Figura 15).

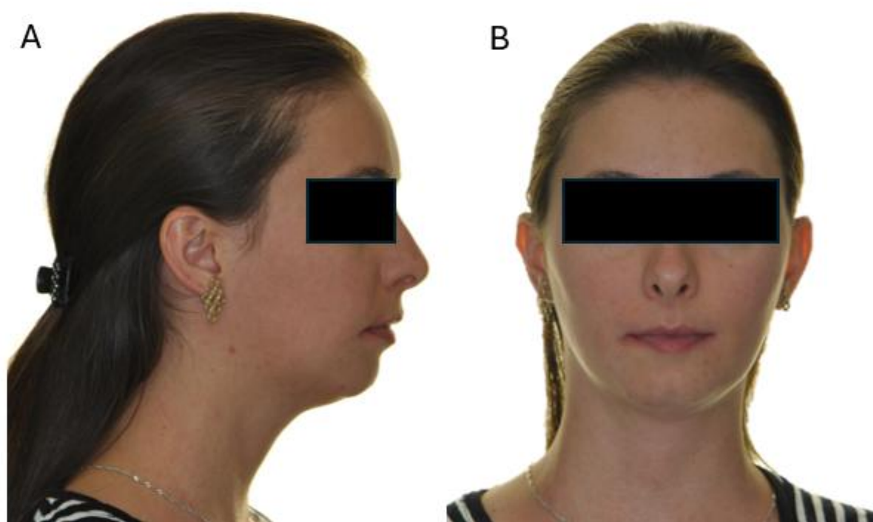

Figura 14: Sem alterações faciais significativas ao final do tratamento. A: Fotografia facial lateral B: Fotografia facial frontal.

Figura 15: Fotografia de sorriso final evidenciando o fechamento da mordida aberta anterior com uma melhora significativa da exposição dos incisivos superiores e manutenção da linha do sorriso consoante.

O caso foi finalizado com os molares em Classe II e os caninos em Classe I, devido às ausências dos primeiros pré-molares que foram extraídos no tratamento ortodôntico prévio ao presente tratamento. As irregularidades do alinhamento dentário e a mordida aberta anterior foram eliminadas. As guias dos incisivos e dos caninos foram restabelecidas, garantindo os princípios de uma oclusão mutuamente protegida. A sobressalência e a sobre mordida finais foram de 2 mm (Figura 16).

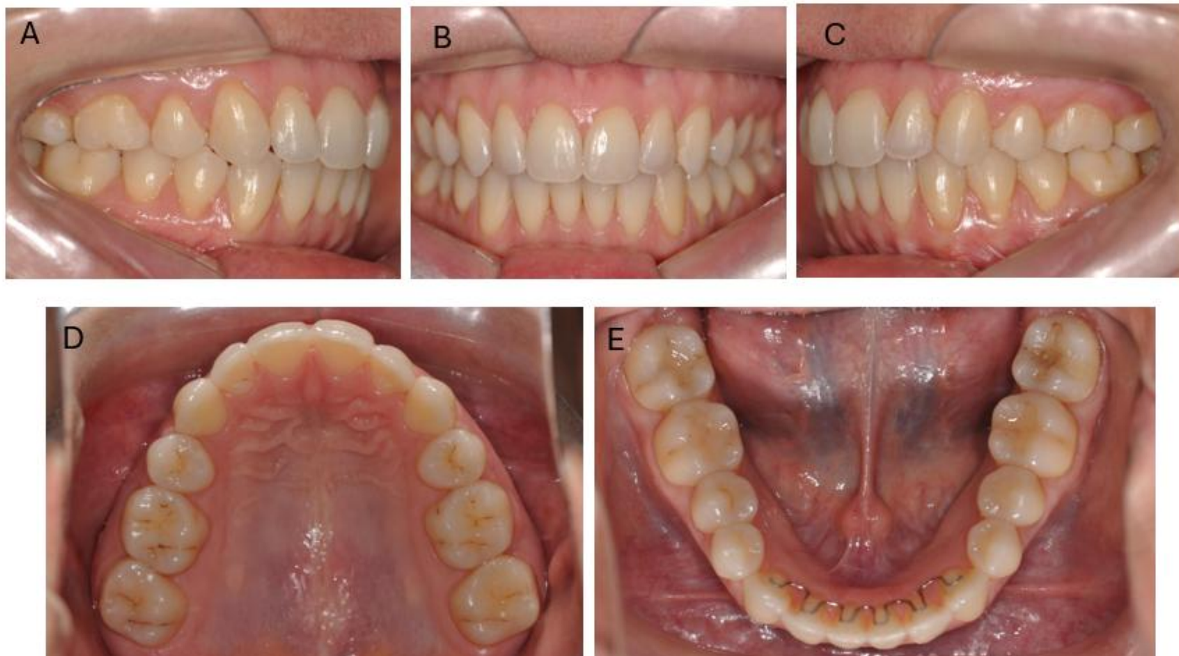

Figura 16: As irregularidades do alinhamento dentário e a mordida aberta anterior foram eliminadas. A sobre mordida final foi de 2mm. A: Vista lateral direita em oclusão B: Vista frontal em oclusão C: Vista lateral esquerda em oclusão D: Vista oclusal arcada superior E: Vista oclusal arcada inferior.

A análise cefalométrica final demonstrou que a principal alteração produzida foi a rotação anti-horária da mandíbula, contribuindo para o fechamento da mordida aberta anterior e diminuição da convexidade facial. Os incisivos superiores sofreram uma inclinação vestibular, enquanto os incisivos inferiores foram inclinados para lingual (Figura 17 e Tabela 2).

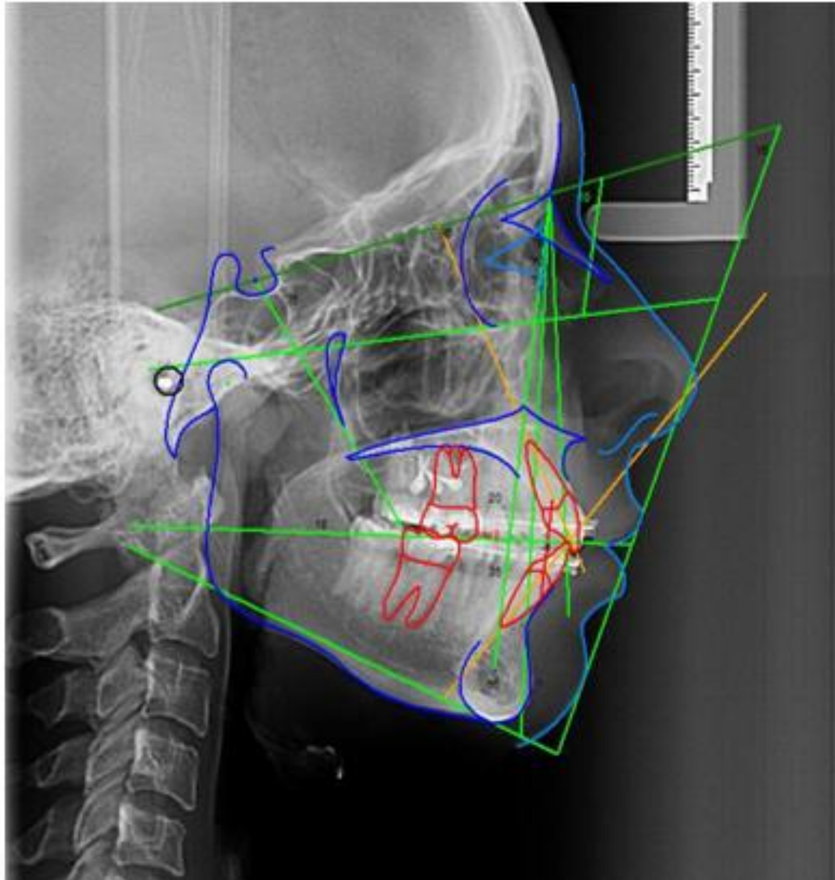

Figura 17: Telerradiografia de perfil com traçado cefalométrico final demonstrando que a principal alteração foi a rotação anti-horária da mandíbula, contribuindo para o fechamento da mordida aberta anterior.

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Tabela 2: Análise cefalométrica final.

Variável	Norma	Início	Final	Diferença Início-Final
SNA (º)	82	78	78	0
SNB (º)	80	71,5	74	-2,5
ANB (º)	2	6,5	4	-2,5
FMA (º)	25	33,5	33	0,5
SN-GoMe (º)	32	41,8	40	1,8
Eixo Y (º)	67	74,8	74	0,8
1.NA (º)	22	18,7	20	-1,3
1-NA (mm)	4	2,0	2,0	0
1.NB (º)	25	37,0	35,3	1,7
1-NB (mm)	4	8,0	7,0	1
IMPA (º)	90	103,8	100,0	3,8
Âng. Interincisal (º)	131	117,8	120,0	-2,2
H. NB (º)	10,5	13,7	10,0	3,7

Fonte: Autores

A sobreposição total dos traçados cefalométricos confirma a rotação anti-horária da mandíbula e mostra uma posição mais anterior do mento ao final do tratamento. A sobreposição da maxila indica o movimento distal e intrusão dos primeiros molares e uma discreta inclinação vestibular das coroas dos incisivos centrais, enquanto a sobreposição da mandíbula mostra que ocorreu a inclinação lingual dos incisivos inferiores (Figura 18).

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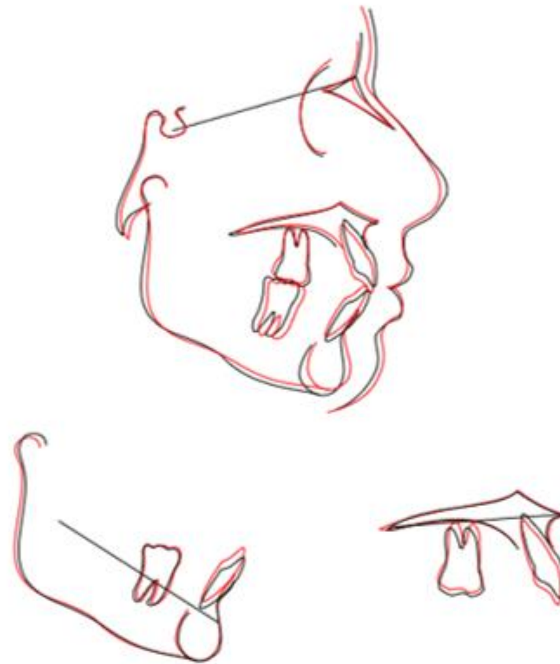


Figura 18: Sobreposições cefalométricas: linha preta – inicial; linha vermelha – final. A sobreposição total dos traçados cefalométricos confirma a rotação anti-horária da mandíbula e mostra uma posição mais anterior do mento ao final do tratamento.

Foi utilizada contenção fixa dos molares superiores aos mini-implantes vestibulares, confeccionadas com fio de aço inoxidável 0,5mm, bilateralmente, para evitar a recidiva da intrusão.

Ainda no arco dentário superior foi utilizada uma placa de acetato de 0,8mm de espessura associada a *attchments* vestibulares nos incisivos e caninos para evitar a intrusão destes.

No arco dentário inferior foi utilizada contenção fixa colada na face lingual dos incisivos e caninos inferiores. O tempo recomendado de uso das contenções foi de 12 meses (Figuras 19 e 20).

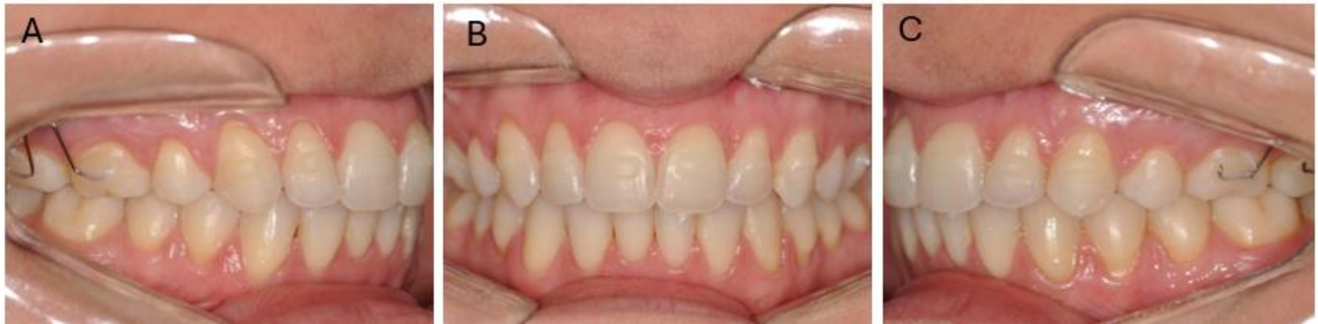
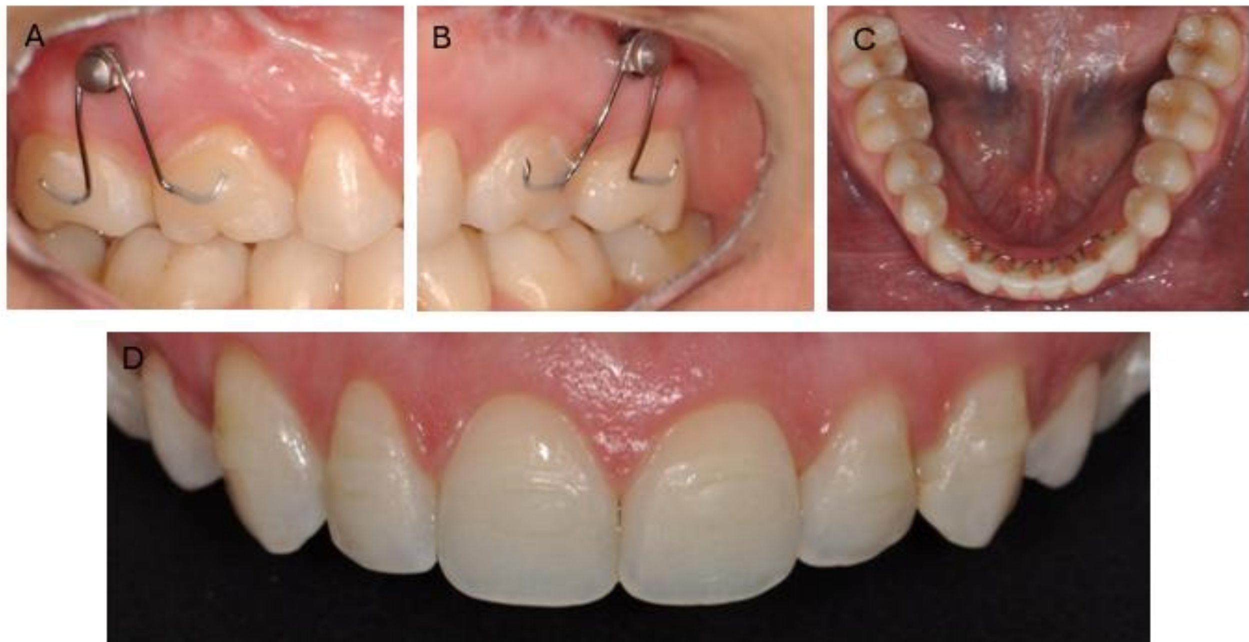


Figura 19: Fotografias intrabucais finais após a instalação das contenções fixas superiores A: Vista lateral direita B: Vista frontal C: Vista lateral esquerda.



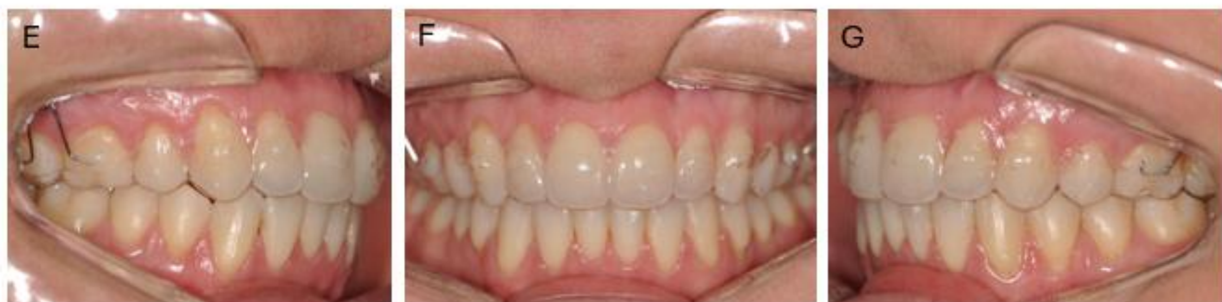


Figura 20: Contenção ortodôntica após finalização do tratamento A: Contenção em mini-implante direito B: Contenção em mini-implante esquerdo C: Contenção palatina inferior D: *Attchments* em dentes superiores E: Vista lateral direita com contenções fixa e removível superior F: Vista frontal com contenções fixa e removível inferior G: Vista lateral esquerda de contenções fixa e removível superior.

.

Discussão

A mordida aberta anterior (MAA) é uma má oclusão desafiadora para os ortodontistas, considerando que apresenta etiologia diversa e multifatorial, produzindo alterações esqueléticas, oclusais, funcionais e estéticas. Além das

dificuldades que podem ser observadas durante o tratamento, principalmente em pacientes adultos, a MAA apresenta ainda alta tendência de recidiva.

No caso relatado no presente artigo a MAA foi classificada como sendo de natureza esquelética uma vez que a paciente apresentava um padrão de crescimento vertical (excesso maxilar vertical, rotação anti-horária do plano palatino, rotação horária da mandíbula, ângulo do plano mandibular aumentado, ângulo goníaco aberto, altura facial anteroinferior aumentada e altura facial posterior diminuída), alterações dentárias, como aumento da altura dento alveolar posterior e divergência dos planos oclusais superior e inferior, além de atividade muscular desfavorável, afetando lábios, língua e músculos mastigatórios.

Com base em um minucioso diagnóstico foi definido que a intrusão dos molares superiores seria necessária para corrigir a mordida aberta e promover a rotação mandibular anti-horária, como alternativa à cirurgia ortognática. A literatura apresenta diferentes métodos para a intrusão de molares superiores e inferiores. Estudos mostram que a ancoragem esquelética, utilizando mini-implantes e miniplacas, é uma excelente opção para evitar movimentos dentários indesejados e fornecer maior controle biomecânico[29].

A mecânica de intrusão de molares superiores com ancoragem esquelética pode ser realizada com a aplicação de forças por vestibular e/ou lingual. A aplicação de força apenas por vestibular promove a inclinação vestibular dos dentes associados à mecânica. De igual modo, quando a força é aplicada apenas por lingual ocorre a inclinação dos dentes na mesma direção. Estes modelos de aplicação de força podem ser utilizados quando os dentes apresentam inclinações vestibular ou lingual acentuadas ao início do tratamento. Quando a intrusão absoluta é necessária, a força resultante deve passar pelo centro de resistência dos dentes a serem movimentados. Para estes casos, deve ocorrer a associação de forças isoladas (vestibular ou lingual) com dispositivos de estabilização, como um arco transplatino, por exemplo, ou devem ser aplicadas forças por vestibular e lingual. Para viabilizar a aplicação de força por vestibular podem ser usados mini-implantes e miniplacas. Por palatino apenas a utilização de mini-implantes é viável[30].

No presente caso clínico, a intrusão de molares superiores foi iniciada utilizando a biomecânica por palatino com mini-implantes porque os molares superiores estavam inclinados para vestibular com contatos mais pesados nas pontas das cúspides palatina. Após a correção inicial foram instaladas miniplacas por vestibular para produzir a intrusão absoluta destes dentes. Como é relatado na literatura, as miniplacas podem causar inflamação gengival e desconforto para o paciente, limitando o seu uso. Foi o que ocorreu no tratamento em discussão, o que levou a substituição das minis placas por mini-implantes também por vestibular[8].

A utilização da ancoragem esquelética permitiu uma movimentação controlada e precisa, o que resultou em uma correção eficaz da mordida aberta anterior. Os resultados foram bastante significativos após 23 meses de tratamento. Os caninos foram finalizados em Classe I e os molares permaneceram em Classe II (devido às extrações prévias dos pré-molares superiores) após a correção da mordida aberta anterior. A sobre mordida de 2 mm obtida foi considerada clinicamente aceitável e está dentro dos parâmetros normais[31,32].

A sobreposição cefalométrica demonstrou que a biomecânica empregada foi efetiva na intrusão dos molares superiores produzindo a rotação anti-horária da mandíbula, o que favoreceu o fechamento da mordida, a projeção do tecido mole do mento e a redução da altura facial anteroinferior. A associação com elásticos verticais nos caninos superiores e nos caninos e primeiro pré-molares inferiores contribuiu no fechamento da mordida, produzindo uma pequena extrusão dos incisivos. Embora o perfil facial tenha permanecido inalterado, a melhora na exposição dos incisivos superiores contribuiu para a melhora estética do sorriso e aumentou a satisfação da paciente[33].

Antes do tratamento ortodôntico atual, a paciente recebeu atenção relacionada à DTM para o controle dos sinais e sintomas. A oclusão inadequada pode agravar os sintomas de DTM e a correção ortodôntica pode melhorar significativamente as funções articulares[33]. O reposicionamento mandibular causado pela intrusão molar e a correção da relação oclusal pode ter contribuído para estabilizar a DTM. Estudos indicam que a correção da mordida aberta e o realinhamento adequado dos arcos dentários frequentemente aliviam a sobrecarga na articulação temporomandibular[34]. Mesmo após a conclusão do tratamento ortodôntico, há a necessidade de monitorar a evolução do quadro articular, por se tratar de uma condição crônica. Além do bem-estar da paciente (ausência de dor temporomandibular e de queixas funcionais), é necessário avaliar periodicamente a estabilidade

morfológica das ATM.

Um dos maiores desafios no tratamento da mordida aberta anterior é a recidiva, principalmente em pacientes adultos e com má oclusão Classe II. As taxas de recidiva podem chegar a 50% após tratamentos convencionais e são mais prováveis em pacientes com padrões de crescimento desfavoráveis[35], como a rotação mandibular horária observada na paciente deste caso.

Considerando o risco de recidiva, é importante estabelecer um protocolo eficiente para a manutenção dos resultados obtidos no tratamento da MAA com a intrusão de molares. No presente caso clínico os molares superiores foram conectados aos mini-implantes para evitar a extrusão e foram utilizados *attchments* nos dentes anteriores associados a placa de acetato para evitar a intrusão e a consequente recidiva da sobremordida por 12 meses. Também foram indicados exercícios de reeducação e fortalecimento muscular. O acompanhamento contínuo é essencial para garantir que as correções permaneçam estáveis a longo prazo, conforme indicado na literatura sobre estabilidade pós-tratamento[36].

Conclusão

A correção da mordida aberta anterior (MAA) esquelética foi realizada de forma eficaz por meio da intrusão dos molares com o uso de ancoragem esquelética. Além de atuar na correção da MAA, a intrusão dos molares contribuiu para a melhoria de condições associadas, como o perfil retrognático comumente observado em pacientes Classe II de Angle, conforme o caso discutido. O êxito desse tipo de abordagem terapêutica esteve intimamente ligado a um diagnóstico preciso e a um planejamento baseado em princípios biomecânicos adequados e colaboração do paciente. Esse método de tratamento ofereceu vantagens, como menor grau de invasividade e maior conforto ao paciente. A utilização de estratégias adequadas para a contenção dos resultados obtidos foi essencial para a estabilidade do caso durante o período de observação. Sugere-se que estudos longitudinais sejam conduzidos para se conhecer melhor os efeitos e a estabilidade em longo prazo da correção da mordida aberta com a intrusão de molares.

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JOIS

CLINICAL STUDY

Effects of osseodensification on implant primary stability in sites with reduced bone density: a five-year multicenter retrospective clinical study

ESTUDO CLÍNICO

Efeitos da osseodensificação na estabilidade primária de implantes em sítios com densidade óssea reduzida: um estudo clínico retrospectivo multicêntrico de cinco anos.

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Keywords:
Osseodensification; dental implants; bone density; osseointegration.

Abstract

Objectives: This retrospective study aimed to evaluate primary stability of dental implants with different macro designs placed in sites with low bone density using osseodensification (OD) instrumentation.

Material and methods: A total of 254 implants with 6 different macro designs were placed in 184 subjects (Females: 93, Males: 91) in 4 different treatment centers. Follow-up assessments ranged between 13 and 65 months. Implant primary stability measured by insertion torque value (ITV), was the primary outcome variable measured. Secondary outcome measures included implant stability quotient (ISQ) at different implant locations (maxilla vs. mandible), and implant success rate post definitive loading over the duration of the study. ISQ was measured at implant insertion and on a weekly basis at 1, 2, 3, 4, 5, and 6 weeks.

Results: All osteotomies were performed in low density bone (D3-D4) using OD instrumentation. ITV obtained for all implant systems, regardless of its geometry, demonstrated ITV greater than 40Ncm in sites with reduced bone density (D3, D4). ISQ values measured from weeks 0-6 revealed that all implant systems demonstrated high stability values followed by a slight reduction by week 3. ISQ values at week 6 were comparable to baseline for all implants placed. The overall success rate observed was 97.7%.

Conclusions: This multicenter retrospective study demonstrated that OD instrumentation is a safe method to achieve optimal primary stability in areas with low bone density, irrespective of implant macro design and surface characteristics. OD instrumentation resulted in high implant success rate.

Palavras-chave:
Osseodensificação; Implantes dentários; Densidade óssea; Osseointegração.

Resumo

Objetivos: Esse estudo retrospectivo visou avaliar a estabilidade primária de implantes dentários com diferentes macros geometrias instaladas em sítios de baixa densidade óssea usando os princípios da osseodensificação (OD).

Material e métodos: Um total de 254 implantes com 6 diferentes macros geometrias foram instalados em 184 pacientes (93 mulheres e 91 homens) em 4 diferentes centros de tratamento. As avaliações de acompanhamento variaram entre 13 e 65 meses. A estabilidade primária do implante, medida pelo valor do torque de inserção (ITV), foi a principal variável de desfecho avaliada. As medidas secundárias de desfecho incluíram o quociente de estabilidade do implante (ISQ) em diferentes localizações (maxila vs. mandíbula) e a taxa de sucesso dos implantes após a carga definitiva ao longo da duração do estudo. O ISQ foi medido no momento da inserção do implante e semanalmente nas semanas 1, 2, 3, 4, 5 e 6.

Resultados: Todas as osteotomias foram realizadas em osso de baixa densidade (D3–D4) utilizando instrumentação de OD. Os valores de ITV obtidos para todos os sistemas de implantes, independentemente de sua geometria, demonstraram valores superiores a 40 Ncm em sítios com densidade óssea reduzida (D3, D4). Os valores de ISQ medidos entre as semanas 0 e 6 revelaram que todos os sistemas de implantes apresentaram altos valores de estabilidade, seguidos por uma leve redução até a semana 3. Na semana 6, os valores de ISQ foram comparáveis aos valores basais para todos os implantes instalados. A taxa geral de sucesso observada foi de 97,7%.

Conclusões: Este estudo retrospectivo multicêntrico demonstrou que a instrumentação de OD é um método seguro para alcançar estabilidade primária ideal em áreas com baixa densidade óssea, independentemente da macro geometria e das características de superfície do implante. A instrumentação de OD resultou em uma elevada taxa de sucesso dos implantes.

Introducion

Dental implants have been considered as a viable and predictable treatment option for the replacement of missing teeth[1-4]. Implant macro design, bone-biomechanical interface, implant connection, and bone density are well reported factors in the literature to influence healing, adequate bone-to-implant contact (BIC), and osseointegration after implant insertion [5,6]. Osseointegration is a histological term defined as a direct structural and functional connection between living bone and the surface of a load-bearing implant at light microscopy[6]. The clinical manifestation of osseointegration is the absence of implant mobility, and is known as functional ankylosis[5,6]

Implant primary stability results from the mechanical engagement of an implant with the surrounding bone[7], whereas timely post-surgical bone deposition and remodeling determine the secondary (biological) stability of the implant[8]. The primary stability, which is essential for osseointegration, depends mainly on bone-to-implant adaptation and mechanical engagement[9]. It is clinically determined by insertion torque, which is an indicator that measures the axial friction resistance between the implant body and the osteotomy walls. Three main factors are known to affect primary stability: bone quantity and quality, the mechanical shape (macro design) of the fixture placed in the bone, and the surgical instrumentation[10-13]. Secondary stability involves uneventful initial healing process around the dental implant that leads to intramembranous bone deposition around the implant body[14]. It clinically assesses the implant micro deflection. It is measured by implant stability quotient (ISQ), which is a parameter related to time with a scale of 0-100, and is used to clinically assess implant stability over time during the early weeks of healing post implant placement[10]. The biological stability subsequently reaches its lowest parameter at three weeks post implant placement[15], then progressively increases with time to reach its initial level as the surrounding bone heals and remodels[16]. This transition of biological stability occurs as bone apposition to the implant progresses, which securely stabilizes the implant in place[17].

Studies investigating drilling methods for endosteal implant placement have relied mainly on subtractive drilling methods. A novel, non-subtractive universal bone drilling protocol known as Osseodensification (OD) has been developed[18]. It is defined as a dynamic non-subtractive bone instrumentation method that relies on bone plasticity to expand a pilot osteotomy and subsequently enhance bone density through compaction auto-grafting[18,19]. It has been shown to cause a controlled plastic deformation of bone due to rolling and sliding contact with specially designed densifying burs[20,21]. These burs operate in both clockwise (CW) and counterclockwise (CCW) directions and have been compared to standard drills during osteotomy preparation[18]. When run in CCW directions, the densifying burs demonstrated significant bone compaction into the walls of the osteotomy sites when compared to the standard drills[18,19]. Bone compaction has been reported as a method to improve early fixation stiffness and strength of implants[18,19]. Compaction auto-grafting achieved with the densifying burs supplements the basic bone compression effect to further densify the osteotomy inner walls creating this density crust along the entire depth of the osteotomy, resulting in a well-adapted bone-to-implant surface[22]. The improvement of the early fixation strength is a result of both larger bone volume in the proximity of the implant and the gentle reversed compressive forces of the compacted bone towards the implant, also known as the “spring-back effect”. It has been shown that bone compaction resulted in higher BIC and higher bone morphogenetic protein (BMP) expression, which accelerates bone formation by 50x (Regional accelerated phenomenon – RAP)[23]. Perfect three-dimensional congruity will not exist between a surgically prepared bone site and the surface of a dental implant[24], since micro and macro-gaps or spaces at the interface will remain, as alluded by Brånemark[5,6]. Gaps between the osteotomy and the body of the implant will be filled with a blood clot soon after surgery. If the implant remains stable, bone heals in these gaps by a process known as intramembranous bone formation[25]. Intramembranous bone formation proceeds through a well-defined sequence of steps, including blood clot formation, angiogenesis, osteoprogenitor cell migration, woven bone formation, compaction of woven bone by deposition of parallel-fibered and lamellar bone, and eventually secondary remodeling of the woven bone[17]. Bone compaction through osseodensification not only improves implant primary stability but also reduces the level of implant micromotion and subsequently accelerate the process of the intramembranous bone formation around the implant body[18,19]. In terms of healing time, it has been reported that bone goes through significant biological changes from the implant insertion day through the first six weeks of wound healing[26], it starts by the formation of new bone until bone remodeling at six weeks and continues until week 18[27]. With osseodensification, the compaction autografting of autogenous bone provides spring back effect that leads to higher implants stability without the need to undersizing the osteotomies[28].

Furthermore, this compaction autografting also allows for faster formation of woven bone and subsequent deposition of bone, which enhances the implant healing process[18].

Osseodensification has been clinically documented as a universal bone instrumentation method that enhances alveolar bone vertical and lateral quantity as well as its quality for optimal implant primary and secondary stability in both the mandible and maxilla. The aim of this study was to retrospectively evaluate OD protocols on implants primary stability, in sites with reduced bone density, and examine the long-term survival rate of implants with different macro designs.

Materials and Methods

This retrospective analysis was carried out in accordance with the Ethical standard according to 1964 Declaration of Helsinki and the directives given by IntegReview Institutional Review Board, which has determined retrospective this retrospective clinical study is considered exempt. An informed consent form was signed by all patients included in the study, both for the clinical procedure and follow-up appointments. All treatment steps and data collection were part of the routine procedures at the centers, and no extra measures were taken for the purpose of the study. All examiners were blind, since a random case number was allocated to the extracted data, ensuring patient anonymity and data protection. The study was structured following the STROBE statement.

A total of 254 implants were placed in 184 patients treated between May 2012 and December 2017 in four centers, by four early adopters of osseodensification (OD) protocols. These early adopters were calibrated on clinical bone density assessment according to Misch's classification as well as extensive calibration and training in OD protocols. No prior sample size calculation was performed due to the retrospective nature of the study. Inclusion criteria included ASA I and II patients, including subjects with controlled systemic conditions (well-controlled diabetes mellitus, hypertension) and light smokers (< 10 cigarettes/day) to have a realistic representation of the average dental implant patient population. Patients not systemically stable to undergo surgical procedures as assessed by primary care provider, heavy smokers (> 20 cigarettes/day), and without adequate bone volume for implant placement (< 8mm vertical, <5mm horizontal) were excluded from this study.

When low bone density was suspected through CBCT examination (D3 or D4 bone density), osseodensification (OD) protocols for implant site preparation were implemented following the use of a standard pilot drill, according to manufacturer Densifying Reference Guide[1]. Implants were placed in native bone or in sites that had been previously grafted (at least 3 months before implant placement for hard tissue augmentation and at least 2 months for soft tissue augmentation), in the maxilla and mandible. After a crestal incision, mucoperiosteal flaps were elevated to access the osteotomy site. If soft bone (D3-D4) was confirmed clinically with the pilot drill and according to Misch's bone density classification, osteotomy preparation progressed with specific OD protocols for each implant macro design was followed according to manufacturer[1]. Six different implant macro designs were used: Tapered body with triple-lead cutting threads (TSV)[2], Tapered body with non-cutting 0.6mm thread depth (MA)[3] Tapered body with buttress threads (ID), Tapered body with V-shaped threads (NR), Straight body with double threads (NO)[4], and Straight body with V-shaped threads (EV)[5]. All patients received post-operative instructions to maintain a cold and soft diet for forty-eight hours and not to brush the surgical site for two weeks. Post-op medications were as follows: Amoxicillin 875mg 2x/day for 5 days and Tylenol 500mg PRN for pain control. Penicillin-allergic patients were prescribed Clindamycin 300mg 6h for 5 days. Implants were evaluated weekly for ISQ[6] values. Restorative treatment was initiated when ISQ reached ≥ 70.

Insertion torque value (ITV) was the primary outcome variable in this study and was measured utilizing standard insertion torque indicators. Implant stability quotient (ISQ) at 0, 1, 2, 3, 4, 5, and 6 weeks after implant placement in maxilla and mandible, and implant success rate were the secondary outcome variables. Implant success was defined as absence of mobility, pain, radiolucency, marginal bone loss > 1.5 mm, and suppuration.

Data was analyzed with specific software for statistical analyzes[9]. Unpaired two-tailed T-test was used at the implant level; also repeated measure ANOVA and Dunnett's multiple comparison test for intragroup analysis among the different time points within the same implant system; and one-way ANOVA and Tukey's multiple comparison test for inter-group analysis within the same point in time. Failed implants were excluded from the stability analysis but were including as part of the implant success rate reporting.

Results

Subject age ranged from 19 to 94 years-old and patient population included both males and females. Subject demographics is summarized in **(Table 1)**. All osteotomies were performed in low density bone (D3-D4) in both mandibular and maxillary sites, using OD protocols. No postoperative complications at the surgical sites were observed, except for six implants that failed to integrate during early healing (3 in the maxilla and 3 in the mandible) and were surgically removed **(Table 2).** Failed implants did not have weekly ISQ readings. Two other implants could not have weekly ISQ readings since they were placed according to a 2-stage protocol since bone augmentation procedures were performed at the time of implant placement. Overall implant success rate observed was 97.7%.

Table 1: Demographics

	TSV	MA	ID	NO	NR	EV
Males	20	10	15	10	15	22
Females	16	15	29	10	4	16
ASA I	14	14	27	12	12	29
ASA II	22	11	17	8	7	9
Non-smoker	27	19	35	13	16	27
Light Smoker	7	6	9	7	3	11
Mean Age	57.5 (23-79)	61.2 (43-94)	61 (19-82)	58.5 (31-73)	61.5 (47-78)	57.4 (23-79)

Table 2. Distribution of Implants Placed

Groups	Implants	Maxilla	Failed	Mandible	Failed
TSV	62	28	1	34	2
MA	57	26		31	1
ID	45	35	1	10	
NO	26	29		16	
NR	26	17	1	9	
EV	38	21		17	

TSV: ZimVie Taper Screw Vent; MA: Megagen Anyridge; ID: Implant Direct; NO: NeOss; NR: Nobel Replace; EV: AstraTech EV

When comparing ITV at the time of implant placement between maxilla and mandible for each implant system, TSV and ID achieved the highest ITV in both mandible and maxilla (Figure 1). However, all implant systems revealed ITV greater than 40Ncm at the time of placement in sites where soft bone (D3-D4) had been detected. When comparing ISQ values at the time of implant placement between maxilla and mandible for each implant system, TSV and MA achieved the highest ISQ values in the maxilla (Figure 2). In the mandible, the highest values were achieved by ID and EV (Figure 3). However, all implant systems revealed mean ISQ values equal or greater than 70 at the time of placement in sites where low density bone had been detected. All implant systems revealed high ISQ values at the time of placement, with the most significant reduction at week 3, and an increase in secondary (biological) stability after that. Values at week 6 were comparable or greater to baseline for the 6 implant systems, confirming clinical functional ankylosis or osseointegration.

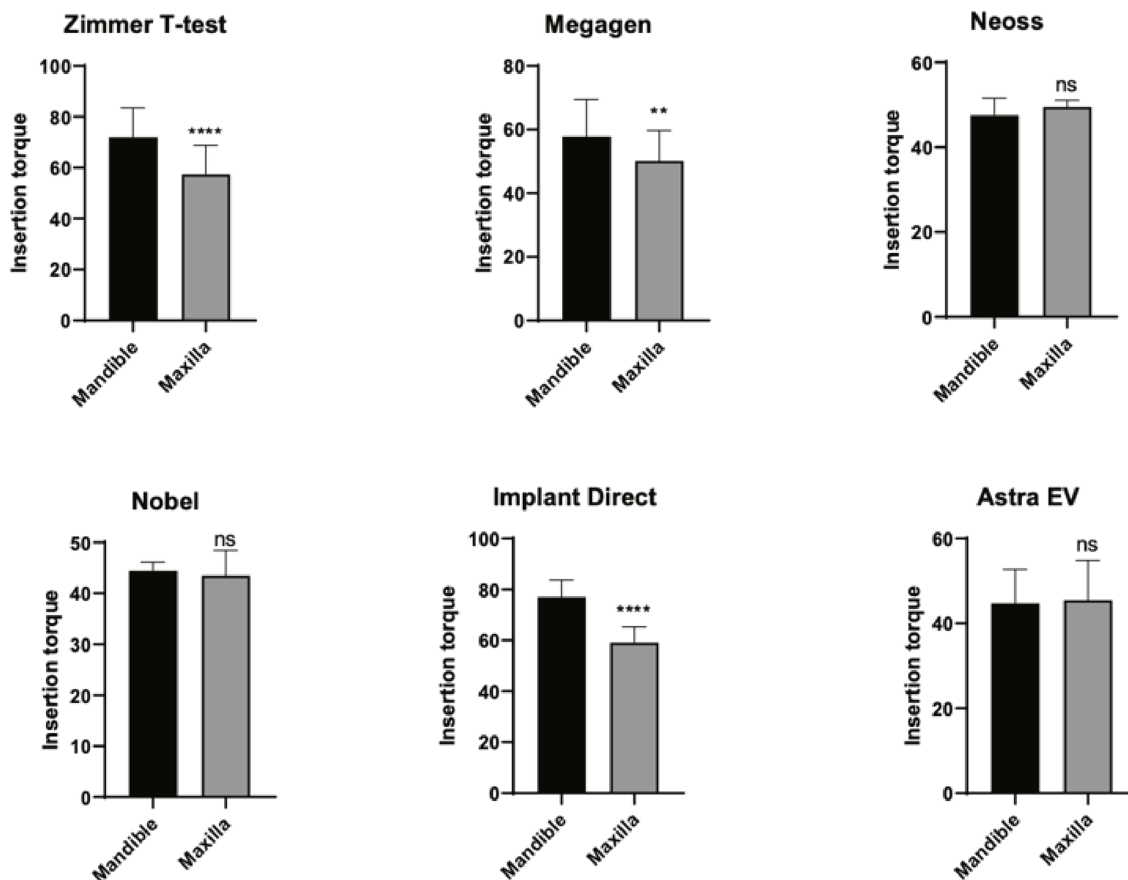

Figure 1 – ITV among the different implants systems in maxilla vs. mandible
Unpaired two-tailed T-test for measurements at the implant level. Significance is compared to mandible. Failed implants were excluded from analysis. **p<0.01; ****p<0.0001; ns – not significant.

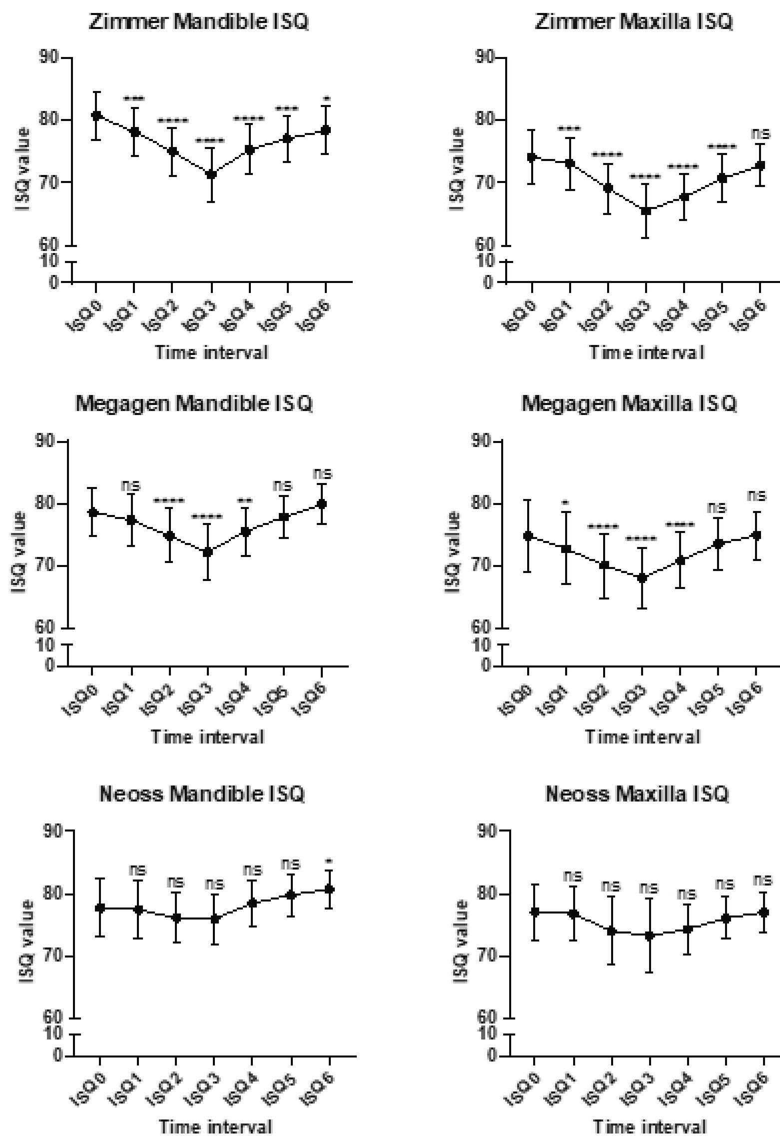

Figure 2 – ISQ values in the mandible from 0-6 weeks after implant placement

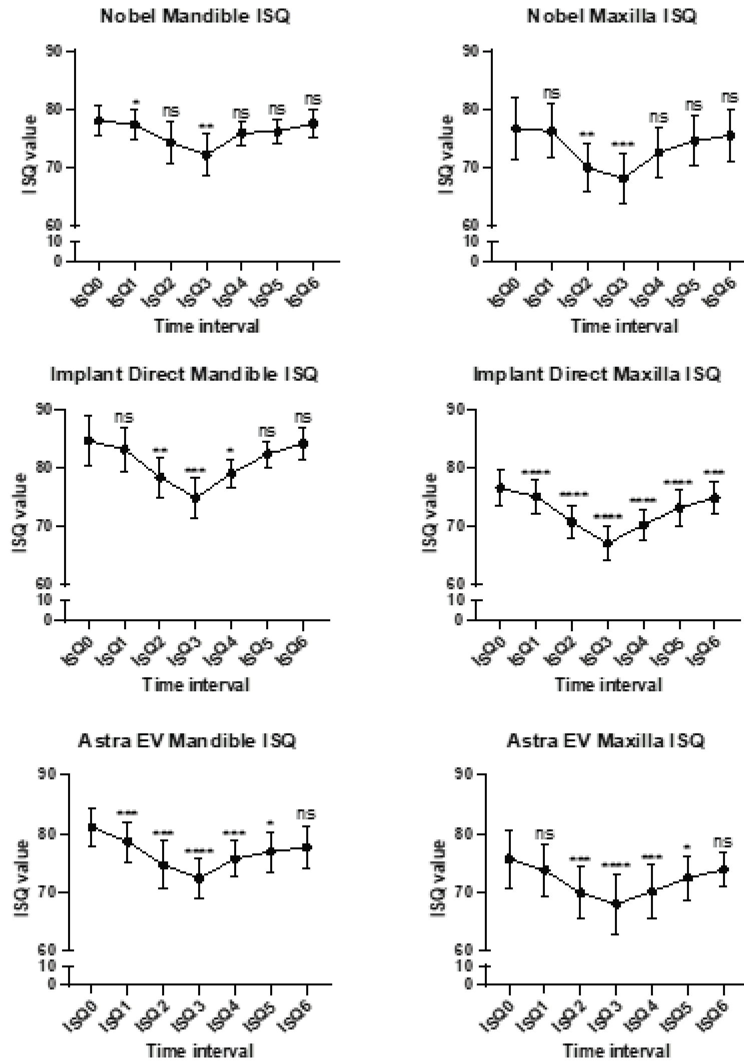

Figure 3 - ISQ in the Maxilla from week 0-6 weeks after implant placement. Repeated measure ANOVA and Dunnett's multiple comparison test; significance is compared to ISQ0 values. Failed implants were excluded from analysis. *p<0.05; **p<0.01; ***p<0.001; ****p<0.0001; ns – not significant.

Inter-group analysis revealed statistically significant higher ITV at the time of placement for TSV and ID in the mandible and for ID in the maxilla (Figure 4). Inter-group analysis of ISQ after 6 weeks revealed statistically significant superior ISQ values for ID in the mandible and for NO in the maxilla (Figure 5). The ISQ values among the other implant systems were not statistically significant.

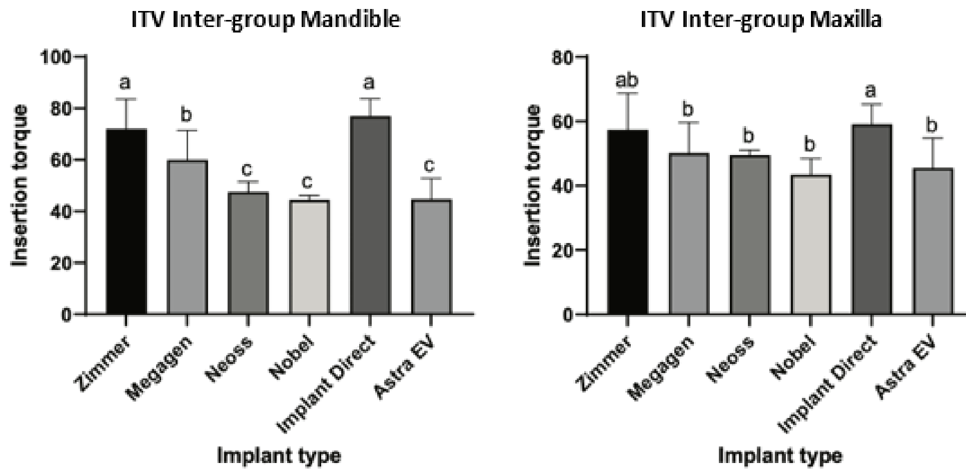

Figure 4 - ITV inter-group analysis in maxilla and mandible according to the implant type. One-way ANOVA and Tukey's multiple comparison test; significant grouping is denoted by (a, b, c). Failed implants were excluded from analysis. Groups with same letter (a and a) are statistically insignificant. Groups with different letters (a vs. b) are different implant systems with statistical significance. Groups with two letters (eg. ab) are statistically insignificant from group a and b. In the mandible, a > b > c, and each group is statistically significant from one another. In the maxilla, ab shares characteristics from both a and b, but it is not statistically significant from either group. There is no single P value since this is a multi-group comparison (eg. some comparison gives p<0.05, some p<0.001).

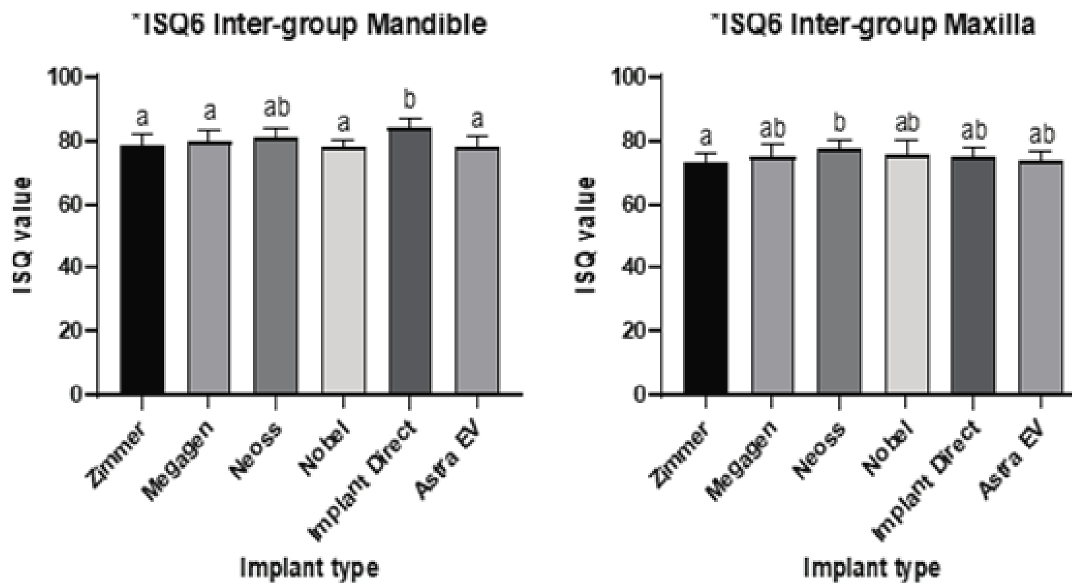

Figure 5 - ISQ inter-group analysis at 6 weeks after implant placement in Maxilla and Mandible according to the implant type. One-way ANOVA and Tukey's multiple comparison test; significant grouping is denoted by (a, b, c). Failed implants were excluded from analysis. Groups with same letter (a and a) are statistically insignificant. Groups with different letters (a vs. b) are different implant systems with statistical significance. Groups with two letters (eg. ab) are statistically insignificant from group a and b.

Discussion

The purpose of this study was to retrospectively evaluate the effects of OD protocols on implant primary and secondary stability of dental implants with different macro thread designs, placed in sites with low bone density.

Higher insertion torque and higher ISQ values are positive indications for diminished implant micromotion, which is critical for enhanced osseointegration and implant immediate loading [29, 30]. Contrary to the historical theory, which has not been proven in either large animal or clinical studies that high ITV above 30 Ncm may create bone compression beyond its physiological limits and may lead to pressure necrosis[31], numerous large animal histological and human clinical studies have confirmed that optimal primary stability measured by high ITV does not prompt or cause implant failure or negatively affect osseointegration[32-34]. Furthermore, implants placed in large patient populations with ITV< 30 Ncm are 14 times more likely to have an early failure than implants placed with ITV > 30 Ncm[35]. Previous studies have found that compaction of autogenous bone with osseodensification preparation provides enhanced implant stability in areas of reduced bone density and leads to optimized implant osseointegration[18,19,36]. The densifying burs, when used in the counterclockwise (CCW) direction, autograft bone particles into open trabecular spaces within the osteotomy walls to increase overall bone density, creating an intimate contact between bone and the implant surface[18,19,36]. It has been demonstrated that if the osteotomy is left empty post OD, a 91% reduction in its diameter was observed due to the viscoelastic nature of the bone and the occurred spring-back effect[18,37].

In the present study, osteotomies created with OD protocols in low density bone, where optimal ITV and high ISQ values are not expected to be obtained, resulted in ITV above 40 Ncm and optimal ISQ ≥ 70 up to 6 weeks after implants placement with different macro designs[38-40]. Hence, it can be concluded that OD protocols increased bone density and implant total stability in these sites, in accordance with previous reports[18,36]. This study also observed that secondary stability, devoted by continuous optimal ISQ values, was achieved for all implant systems during the initial critical 6 weeks of healing, in areas where reduced bone density was previously detected. OD protocols optimized implant primary and secondary stability in low bone density sites. These results are in agreement with previous comparative studies in which OD increased the insertion torque from 25Ncm for implants placed using conventional osteotomy to ≥ 50 Ncm in sites with low density bone[35].

Potential limitations of this study include the absence of a control group for each implant macro design with implants placed following traditional drilling protocols. However, comparisons of conventional to OD protocols have previously reported superior ITV and ISQ values with OD protocols[36] in low bone density sites. Since OD densifying burs used are not implant system-specific and are considered universal, the main goal of this multicenter retrospective study was to determine if similar results would be obtained when placing implants with different macro designs. This study confirmed this hypothesis since implants with different body designs (tapered/ straight) and thread patterns achieved similar results. Hence, within the limitations of this multicenter retrospective study, it can be concluded that the application of OD protocols in sites with low bone density is a safe, viable, and reproducible method of achieving optimal primary and predictable secondary implant stability using implants of different macro designs, leading to high success rates and predictable treatment outcomes. Future controlled longitudinal clinical trials are encouraged to confirm these findings.

Conclusion

This multicenter retrospective study demonstrated that OD instrumentation is a safe method to achieve optimal primary stability in areas with low bone density, irrespective of implant macro design and surface characteristics. OD instrumentation resulted in high implant success rate.

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JOIS

CASE REPORT

The role of the dental surgeon in the diagnosis and treatment of pemphigus vulgaris: case report

RELATO DE CASO

O papel cirurgião dentista no diagnóstico e tratamento de Pênfigo vulgar: relato de caso

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Keywords: Pemphigus; Hospital Dental Service; Autoimmune Diseases

Abstract

Pemphigus vulgaris is a low-prevalence autoimmune disorder characterized by vesiculobullous lesions affecting the skin and mucous membranes. Lesions in the oral mucosa can be the initial manifestations of the disease and highlight the importance of the dentist in early diagnosis. The objective of this study is to report a clinical case of pemphigus vulgaris with oral lesions in a 44-year-old female patient with no comorbidities. Intraoral physical examination revealed ulcerated lesions throughout the oral cavity, accompanied by bullous lesions, ulcerations, and crusts on the skin. The patient reported having had the lesions for four months, with no conclusive diagnosis. These lesions made eating difficult and resulted in marked weight loss and the need for hospitalization. During hospitalization, the diagnosis was established by the medical and dental team based on clinical characteristics and medical history, followed by histopathological confirmation. Oral lesions were treated with 0.12% chlorhexidine digluconate mouthwash and laser photobiomodulation, combined with systemic corticosteroid therapy, resulting in significant remission. Therefore, dentists' knowledge of the clinical and histopathological characteristics of pemphigus vulgaris is essential for early diagnosis and effective treatment, promoting patient health and quality of life. Further studies should be conducted to optimize management strategies for oral lesions in patients with pemphigus vulgaris.

Palavras- chave: Pênfigo; Unidade Hospitalar de Odontologia; Doenças Autoimunes.

Resumo

O pênfigo vulgar é uma desordem autoimune de baixa prevalência, caracterizada por lesões vesículo-bolhosas que acometem pele e membranas mucosas. Alterações na mucosa bucal podem ser as manifestações iniciais da doença, evidenciando a importância do cirurgião-dentista no diagnóstico precoce. O objetivo deste estudo é relatar um caso clínico de pênfigo vulgar com lesões bucais em uma paciente de 44 anos, sem comorbidades. Durante o exame físico intrabucal, foram observadas lesões ulceradas em toda a extensão da cavidade bucal, acompanhadas por lesões bolhosas, ulcerações e crostas na pele. As lesões apresentavam evolução de 4 meses, sem diagnóstico conclusivo. A presença de lesões bucais extensas dificultava a alimentação e culminaram em acentuada perda de peso e necessidade de internamento. Durante o período de internamento, o diagnóstico foi estabelecido em conjunto com a equipe de Odontologia, baseada nas características clínicas das lesões e na história médica, seguido pela confirmação histopatológicas. O tratamento das lesões bucais foi baseado em bochecho com digluconato de clorexidina 0,12% e fotobiomodulação com laser, associado a terapia sistêmica com corticosteroides, e resultou em remissão significativa das lesões. Portanto, o conhecimento dos cirurgiões-dentistas sobre as características clínicas e histopatológicas do pênfigo vulgar é essencial para o diagnóstico precoce e tratamento efetivo, promovendo a saúde e qualidade de vida dos pacientes. Outros estudos devem ser conduzidos visando otimizar as estratégias de manejo das lesões bucais de pacientes acometidos por pênfigo vulgar.

Introduction

Pemphigus vulgaris is an autoimmune disease with an estimated incidence of 14 cases per million individuals per year[1]. This condition is predominantly observed in adults between 40 and 60 years of age, with a slight predilection for females[2-7]. Despite its low prevalence, pemphigus vulgaris has historically been associated with high mortality rates, which have decreased significantly with the use of appropriate drug therapies[8].

The etiology of this autoimmune disorder is characterized by a type II hypersensitivity reaction, in which autoantibodies specific for desmogleins 1 and 3 (Dsg 1 and Dsg 3), adhesion proteins present in the skin epithelium (Dsg 1) and oral mucosa (Dsg 3), are involved. The interaction of autoantibodies with these molecules results in acantholysis and the formation of intraepithelial clefts. Clinically, acantholysis results in the formation of blisters that rupture and develop into painful erosions and ulcers. In addition to severe pain, the most common symptoms include fever, dysphagia, and weight loss.

The diagnosis of pemphigus vulgaris is carried out through clinical examination, associated with complementary exams such as histopathological analyses or direct immunofluorescence[1-4,9,10]. Another procedure that contributes to the diagnosis of pemphigus vulgaris is the positive Nikolsky sign, characterized by the application of sliding pressure on the affected mucosa. This pressure causes the rupture of intracellular adhesion, leading to the formation of blisters that can easily rupture and generate painful ulcerations[1,4,11,12]. Although not a pathognomonic sign, Nikolsky's sign can contribute to clinical diagnosis of this condition[13].

Treatment is based on corticosteroid therapy and is initiated with high doses, which are subsequently adjusted according to the clinical condition[9,10]. In addition to corticosteroids, treatment of pemphigus vulgaris may include immunosuppressive agents, which are often used in combination to improve therapeutic response[7]. These drugs help reduce immune system activity and control autoantibody production, contributing to effective disease management[4,8,12,14].

Lesions are observed on the skin and mucous membranes, with oral lesions commonly preceding skin lesions. Thus, the dentist plays an important role in early diagnosis and treatment. In the oral cavity, lesions can affect all regions of the mucosa. However, they are more common in the palate, buccal mucosa, labial mucosa, and tongue[11]. Therefore, the objective of this study is to report the case of a patient diagnosed with pemphigus vulgaris presenting manifestations in the oral mucosa and skin. In addition, this study aims to describe the clinical approach and emphasize the role of the dentist in diagnosis and treatment.

Case Report

A 44-year-old female patient with leukoderma was admitted to the hospital complaining of multiple skin lesions. The patient reported that the lesions had been present for four months and that the first lesions were located on the oral mucosa. These lesions then spread to the skin on her upper and lower limbs, chest, and back. The patient reported significant weight loss (20 kg) in recent months due to painful symptoms that made eating difficult. The patient had previously undergone dental and medical evaluation with a prescription for intravenous antibiotics, oral antifungals, and antiretroviral therapy, with no improvement in her condition. At this time, the patient reported using itraconazole to treat skin lesions due to suspected fungal infection.

The intraoral examination revealed the absence of all teeth. The patient reported using a full upper denture, but she was unable to use it due to the painful symptoms of the oral lesions. In fact, it was observed multiple and extensive ulcerated and erosive lesions on the bilateral jugal mucosa, dorsum and ventral surface of the tongue, and upper and lower labial mucosa, with bloody exudate and painful symptoms (Figure 1). The extraoral physical examination also revealed ulcerated lesions with overlapping blood crusts in the perioral region, labial commissures, and vesicles near the labial filter (Figure 1).

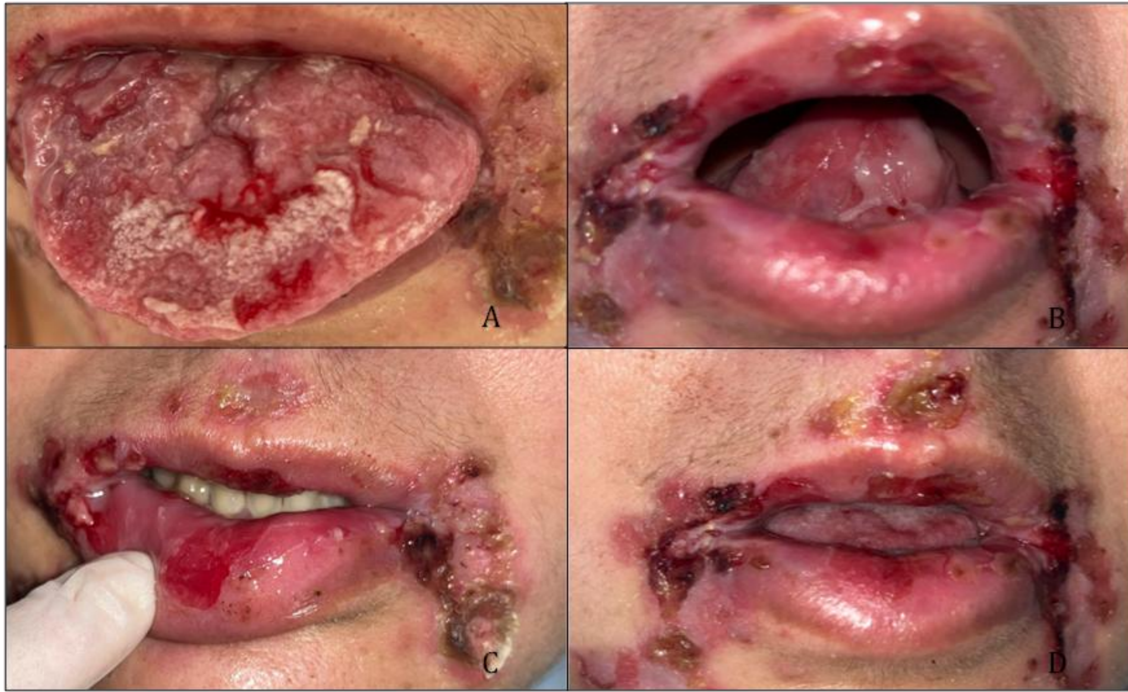

Figure 1. Multiple ulcerated lesions with exposed connective tissue on the dorsum of the tongue (A), ventral surface of the tongue (B), lips (C), and labial commissure (C). Lesions with hemorrhagic crusts in the perioral region (D).

The patient presented ulcerated and crusty lesions on the upper and lower limbs, chest, neck, and dorsal region. In addition, bullous lesions were also identified on the lower limbs (Figure 2). Like the oral lesions, these lesions began with the formation of blisters, which later ruptured, resulting in ulcers. Considering the clinical characteristics of the lesions, the possibility of fungal infections was excluded, and antifungal medication was discontinued. Subsequently, a positive Nikolsky sign was observed, suggesting pemphigus vulgaris as a diagnostic hypothesis.

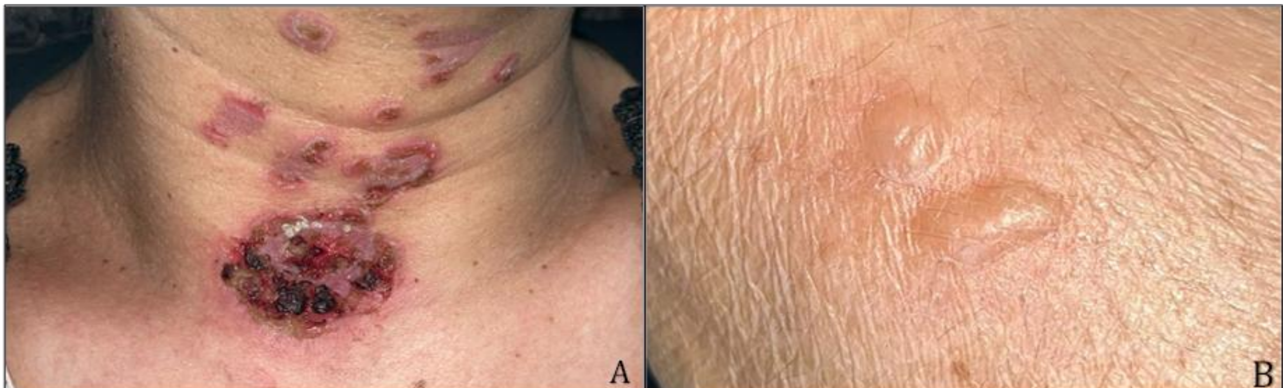

Figure 2. Clinical appearance of the ulcerated and crusted lesions in the chest and neck region (A). Clinical appearance of the vesiculobullous lesions in the lower limbs(B).

In this context, an exfoliative cytology evaluation of the oral lesions was performed to exclude the possibility of fungal lesions. Thus, superficial scraping of the oral lesions was performed with a swab, and the material obtained was rubbed onto a glass slide, stored in 95% alcohol solution, and subjected to histological analysis. In conjunction with this, an incisional biopsy of the skin lesions was performed, since the oral lesions presented more intense painful symptoms. Exfoliative cytology revealed negative results for fungal infection. Thus, Itraconazole (200mg) was suspended and empirical therapy with Prednisone 80mg every 24 hours was initiated, according to the diagnostic hypothesis of autoimmune disease. The histopathological report revealed suprabasal bullous dermatosis with the presence of acantholytic cells. Based on these data, the diagnosis of pemphigus vulgaris was confirmed.

Mouthwash with 0.12% chlorhexidine digluconate was also prescribed twice a day to control biofilm and prevent secondary infections. In addition, antimicrobial photodynamic therapy sessions were performed with the application of 0.01% methylene blue gel on the lesions for five minutes, followed by the application of a red laser (660 nm | 100 mW) with an energy of 9 J for 90 seconds (Laser DUO - MMO®) (Figure 3). Topical use of triamcinolone 1mg/g twice a day was also prescribed.

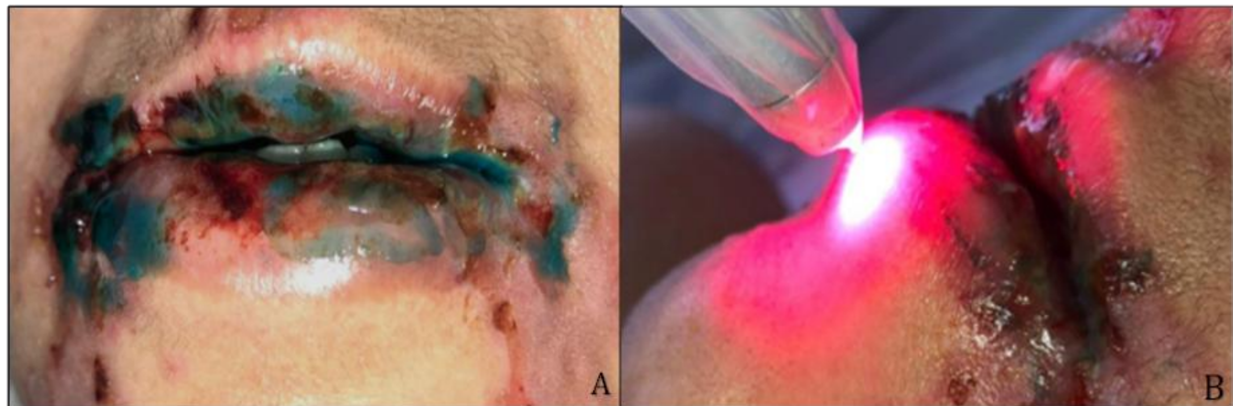

Figure 3. Antimicrobial photodynamic therapy with application of 0.01% methylene blue gel on the ulcerated lesions in the oral cavity and perioral region (A). Application of red laser (660nm | 100 mW) with a dose of 9J for 90 seconds (B).

Antimicrobial photodynamic therapy was alternated with photobiomodulation therapy (application of red laser – 660 nm, 100 mW, 2J, 20 seconds, spot technique), and the proposed treatment was performed daily throughout the entire period of hospitalization. After 10 days of treatment, the patient reported significant improvement in painful symptoms and remission of oral lesions (Figure 4).

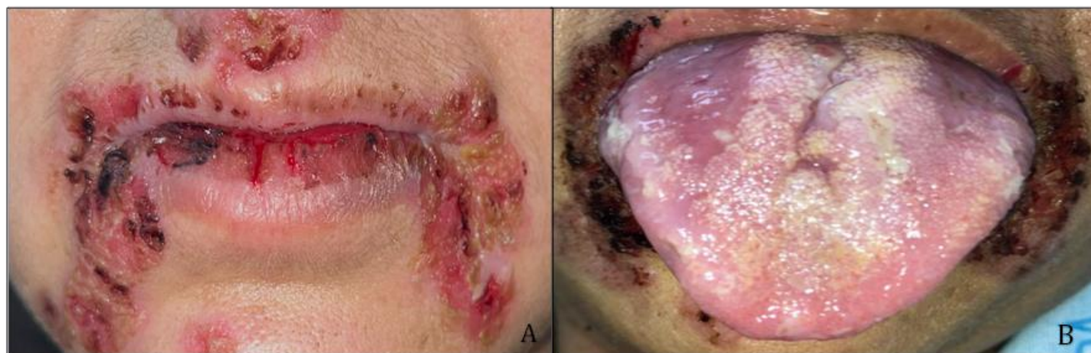

Figure 4. Clinical aspect of the lesions in the perioral region (A) and dorsum of the tongue (B) after 14 days of follow-up

After 10 days of hospitalization, the patient was discharged due to a significant reduction in symptoms and partial remission of the lesions. Treatment with systemic corticosteroids was maintained with a gradual reduction in doses until complete suspension. The patient was kept under weekly dental follow-up for laser photobiomodulation for 2 months until complete remission of the lesions. The patient then continued to be monitored for one year. No recurrence was observed during this period (Figure 5).

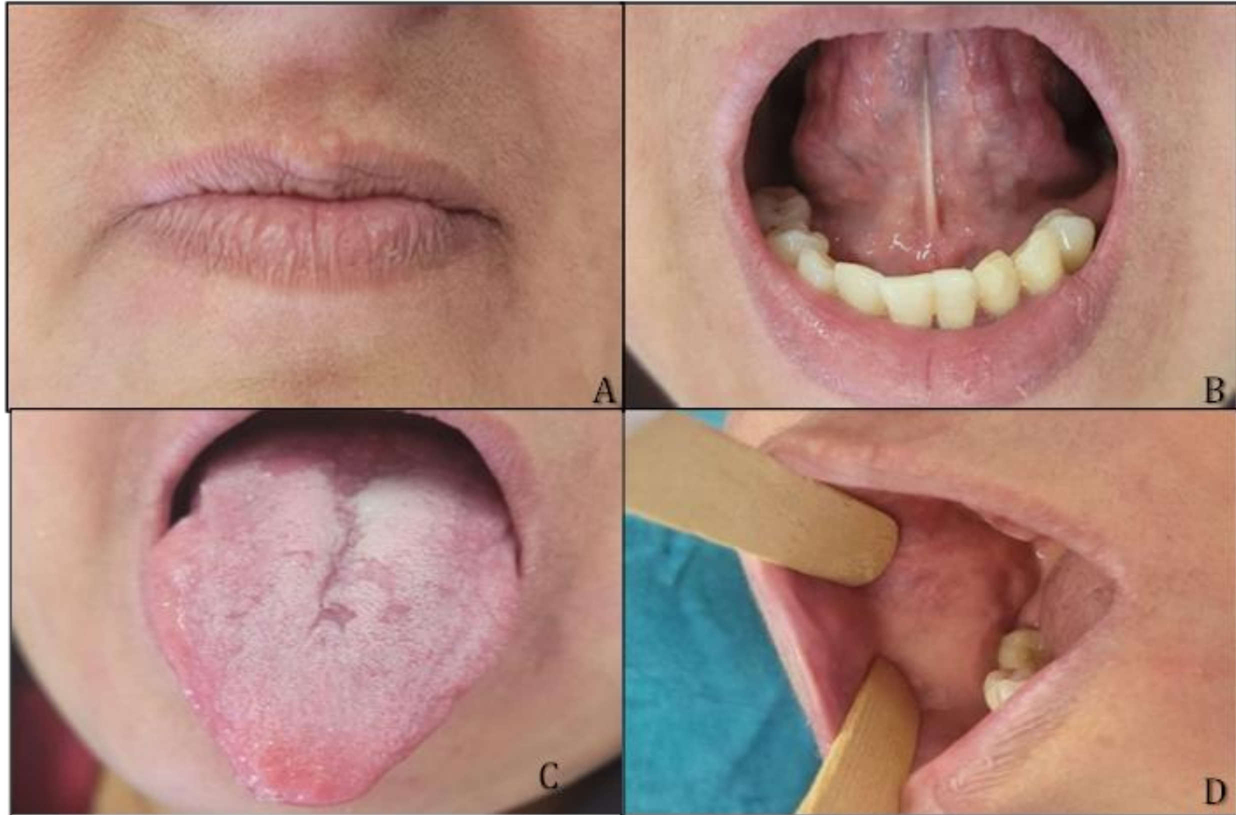

Figure 5. Clinical appearance of the perioral region (A), ventral (B) and dorsal (C) aspects of the tongue, and buccal mucosa (D) after one year of treatment.

Discussion

Pemphigus vulgaris is a mucocutaneous disease characterized by vesicular eruptions, blisters, erosions, and ulcerations affecting the mucous membranes and skin. In about 80% of cases, oral lesions precede skin lesions and are commonly located on the palate, buccal mucosa, lips, gums, and tongue. Ulcerated lesions spread rapidly, with intense painful symptoms intense[7,9,10,15]. The clinical manifestations detailed in the case mentioned correspond to these characteristics.

In addition to clinical features, histopathological evaluation is essential for accurate diagnosis, as pathological conditions such as epidermolysis bullosa and Stevens-Johnson syndrome may share some clinical characteristics[16].

The purpose of therapies for pemphigus vulgaris is to relieve painful symptoms by reducing serum autoantibody levels, either directly or through immunosuppression[8]. In the present case, treatment was based on empirical drug therapy with topical and systemic corticosteroids, in addition to photobiomodulation and antibacterial photodynamic therapy for oral lesions, even before confirmation of the diagnosis. This preliminary approach resulted in significant improvement in painful symptoms until confirmation of the diagnosis was obtained.

Among the therapeutic options, oral or intravenous corticosteroids are the first line of treatment[8,9]. In the clinical case mentioned, prednisone was chosen due to its clinical efficacy. The drug administration protocol varies according to the severity of the disease, usually starting with doses of 0.5 to 2.0 mg/kg/day, with

adjustments according to clinical response[6,15]. Treatment with systemic corticosteroids is often started with high doses, which are then gradually reduced[7,15,17].

In oral lesions of pemphigus vulgaris, topical corticosteroid therapy is often used to reduce inflammation and relieve symptoms[10]. Topical corticosteroids, such as triamcinolone, are used to treat these lesions locally [8,15,17]. In fact, this treatment strategy has supported tissue repair of oral lesions and minimized the inflammatory response[1,14,17].

Several therapeutic alternatives are described for the treatment of pemphigus vulgaris, such as anti-CD-20 agents, anti-CD-25 agents, TNF-α inhibition, FAS Ligand Inhibition, FcRn inhibition, BAFF inhibition, Bruton's tyrosine kinase (BTK) inhibition, CAAR T Cells, JAK inhibition, mTOR inhibition, abatacept, IL-4 inhibition, IL-17 inhibition, IL-6 inhibition, polyclonal Regulatory T Cells, and autologous hematopoietic stem cell transplantation[18].

Low-power laser photobiomodulation is also a promising strategy in the management of oral lesions associated with systemic disorders. This therapy promotes cell proliferation and favors the recovery of affected tissues, contributing to a significant reduction in symptoms[7,17]. In the case presented, the proposed treatment resulted in improved oral hygiene and eating ability in the patient due to pain control[19]. It is important to note that, although this approach is beneficial, it does not replace the use of systemic corticosteroids, which are essential for disease control[17].

Conclusion

The reported case shows that the dental surgeon's knowledge of the clinical characteristics of pemphigus vulgaris is essential for early diagnosis of the disease since oral manifestations may be the first evidence of the disease. In the case presented, the patient had had oral lesions for 4 months without a definitive diagnosis, requiring hospitalization to obtain a diagnosis and effective treatment. Thus, the intervention of the dental surgeon in a hospital setting is extremely important for the management of oral manifestations of systemic diseases. In this case, medical interventions associated with integrated dental treatment optimized the treatment.

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JOIS

CASE REPORT

Management of the atrophic maxilla using remote anchorage with zygomatic and short Implants: a 4-year follow-up case report

RELATO DE CASO

Tratamento da maxila atrófica usando ancoragem remota com implantes zigomáticos e curtos: relato de caso de acompanhamento de 4 anos

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Keywords: : Bone Resorption; Immediate Dental Implant Loading; Zygoma; Case Report

Abstract

This case report presents a rehabilitation of atrophic maxilla employing remote anchorage with zygomatic and short implants in the premaxilla, including a nasopalatine approach. A 47-year-old female patient presented with advanced posterior bone resorption and bilateral sinus pneumatization. Two zygomatic implants were placed for posterior support, and three short implants were positioned in the premaxilla, achieving sufficient primary stability to allow immediate prosthetic loading. The patient was followed at 1, 6, and 12 months postoperatively, with annual monitoring. Satisfactory function and preservation of peri-implant mucosal health were observed throughout the observation period. Radiographic evaluation revealed stable bone levels. No mechanical or biological complications occurred during the 4-year follow-up period. Remote anchorage using zygomatic implants combined with short implants in the premaxilla represents a reliable and graftless approach for the rehabilitation of atrophic maxilla, optimizing anterior–posterior spread, reducing cantilever extension, and promoting biomechanical stability.

Palavras- chave: Reabsorção Óssea; Carga Imediata em Implante Dentário; Zigoma; Relato de Caso.

Resumo

Este relato de caso apresenta a reabilitação de uma maxila atrófica utilizando ancoragem remota com implantes zigomáticos e implantes curtos na região de pré-maxila, incluindo a abordagem do canal nasopalatino. A paciente de 47 anos apresentava reabsorção óssea posterior avançada e pneumatização sinusal bilateral. Dois implantes zigomáticos foram instalados para suporte posterior, e três implantes curtos foram posicionados na pré-maxila, obtendo estabilidade primária suficiente para permitir a carga protética imediata. A paciente foi reavaliada em 1, 6 e 12 meses após a cirurgia, com acompanhamento anual. Observou-se função satisfatória e preservação da saúde da mucosa peri-implantar durante todo o período de observação. Foi observado na avaliação radiográfica níveis ósseos peri-implantes estáveis. Não foram observadas complicações mecânicas ou biológicas durante o período de 4 anos de acompanhamento. A ancoragem remota com implantes zigomáticos, combinada ao uso de implantes curtos em região de pré-maxila, representa uma abordagem confiável e sem a necessidade de enxertos para a reabilitação de maxilas atróficas. A técnica otimiza a distância anteroposterior, reduzindo a extensão do cantiléver e promovendo estabilidade biomecânica.

Introduction

The rehabilitation of atrophic maxilla remains challenging in contemporary implantology. The loss of posterior maxillary alveolar bone often results in a significant reduction of the residual ridge, while the anterior maxillary region typically presents limited bone height and low bone density[1]. Although well-documented bone grafting procedures such as maxillary sinus floor elevation have a high treatment survival rate, they are associated with increased surgical morbidity, prolonged treatment time, and the need for multiple interventions[1-4]. Consequently, patients with moderate-to-severe maxillary atrophy frequently require alternative treatment approaches that optimize the use of the remaining bone or minimize the need for augmentation procedures[5].

Remote anchorage through pterygoid, zygomatic, and nasal implants has expanded treatment possibilities for patients with severe maxillary atrophy[6]. These approaches provide predictable solutions for the rehabilitation of both fully and partially edentulous atrophic maxilla. Among these options, zygomatic implants have gained relevance, offering stable posterior support when conventional implants cannot be placed[7,8]. Introduced by Brånemark, zygomatic implants were developed to enable fixed implant-supported prostheses in patients with advanced maxillary resorption [9,10]. Since then, the use of zygomatic implants has shown survival rates upper to 95% and favorable long-term outcomes [9,11-14].

Another viable alternative treatment for the atrophic maxilla is the use of short dental implants. The use of short implants provides benefits such as less invasive technique compared to bone augmentation procedures, reduced surgical morbidity, treatment cost, and patient discomfort[1,15,16]. Clinical studies have demonstrated high predictability of short implants, with survival rates exceeding 94% in mid- to long-term follow-ups [15,17,18]. Available clinical data indicate that short implants achieve comparable outcomes to standard-length implants placed with maxillary sinus floor elevation [2,19].

Particularly for patients with severe maxillary atrophy, the combination of zygomatic implants in the posterior region with conventional or short implants in the anterior region has been proposed as an alternative treatment [20,21]. This hybrid treatment simplifies surgical procedures, reduces treatment time and cost, and provides favorable functional outcomes in full-arch maxillary rehabilitation.

This case report describes the implant-supported rehabilitation of a patient with maxillary atrophy using zygomatic implants in combination with short implants in premaxilla, with a 4-year follow up period.

Case Report

This clinical case report follows the CARE guidelines (supporting information file 01) and was approved by the Institutional Review Board of ILAPEO College (7.583.973).

Case description

A 47-year-old female patient, classified as ASA I, presented to the ILAPEO College in 2021 with chief complaints of poor esthetics and difficulty in mastication due to discomfort caused by removable prosthesis. The patient also presented missing teeth in the posterior mandible (Figure 1).

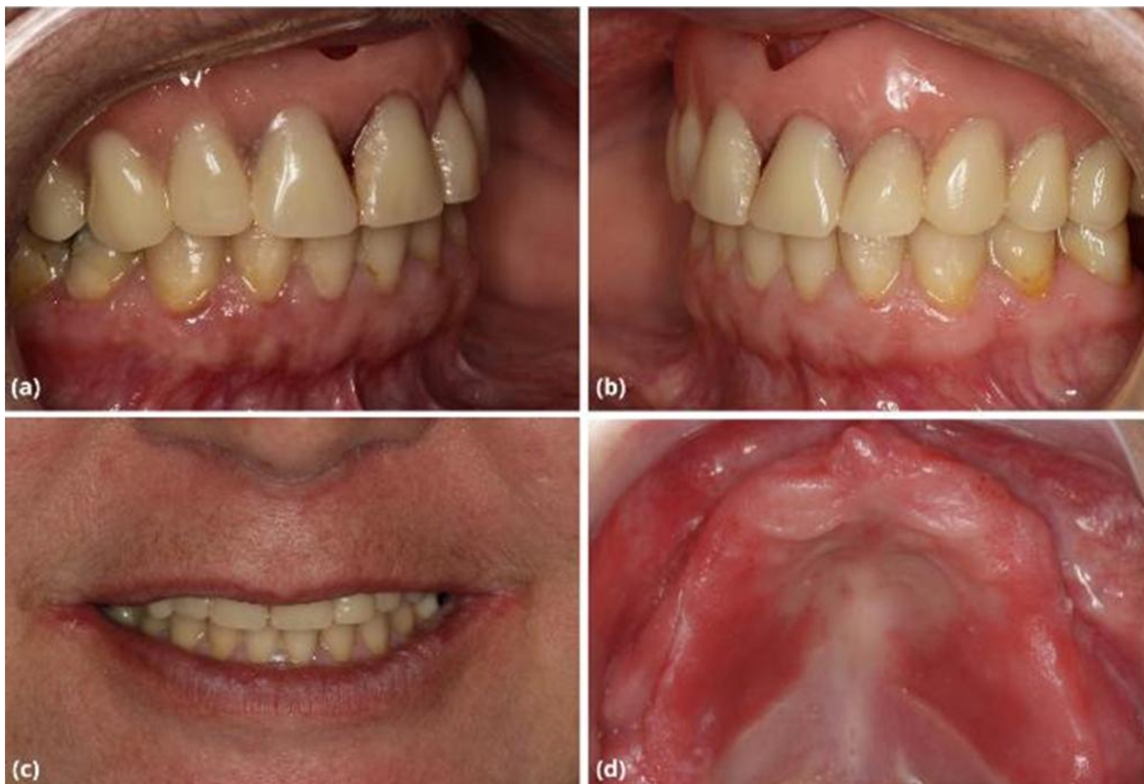
Figure 1 - Initial clinical condition (a-d)

Clinical and radiographic findings

Clinical and radiographic evaluation, including panoramic and cone-beam computed tomography (CBCT) imaging, revealed maxillary bone atrophy. The treatment plan for maxillary rehabilitation with dental implants consisted of the placement of two zygomatic implants and three anterior implants (Figure 2). For the posterior mandible, the proposed treatment included the placement of one implant on each side.

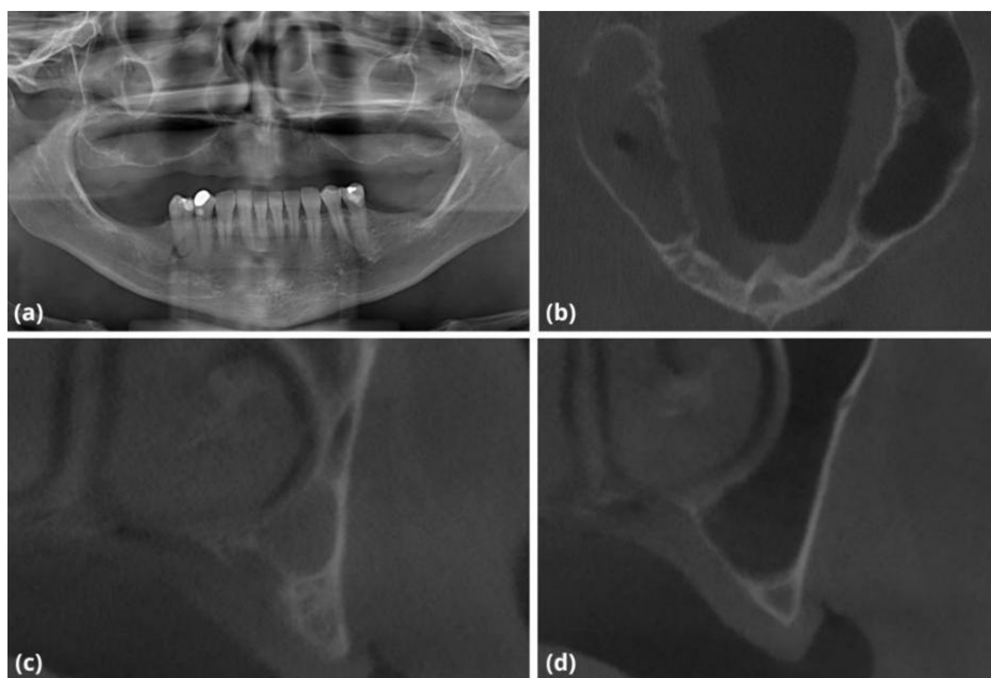
Figure 2. Radiographic findings from the initial situation. Panoramic radiograph (a). Axial and cross-section from the CBCT of maxilla (b-d).

Surgical Procedure

Before the surgical procedure, a multifunctional surgical guide was planned to allow ideal implant positioning and to enable immediate impression taking.

Preoperative medication included diazepam and 4 mg of betamethasone administered one hour before surgery. Local anesthesia with 4% articaine with epinephrine (1:100,000) was administered. After crestal incision and flap elevation, osteotomies were performed according to the manufacturer's recommendations. Two Zygoma-S GM implants (Neodent®, Curitiba, Brazil) measuring 3.75 × 37.5 mm were inserted in the zygomatic bone (Figure 3), and three Helix Short implants (Neodent®, Curitiba, Brazil) were placed in the anterior atrophic maxilla: two implants measuring 3.75 × 8.5 mm (regions #13 and #23), and one 5.0 × 8.5 mm implant placed in the nasopalatine foramen after resection of the nasopalatine canal (Figure 4). Osteotomies were carried out under continuous double irrigation, in accordance with the manufacturer's drilling protocol and recommended rotational speeds. The insertion torque for all implants was 60 N.cm. Bone quality was classified as type II.

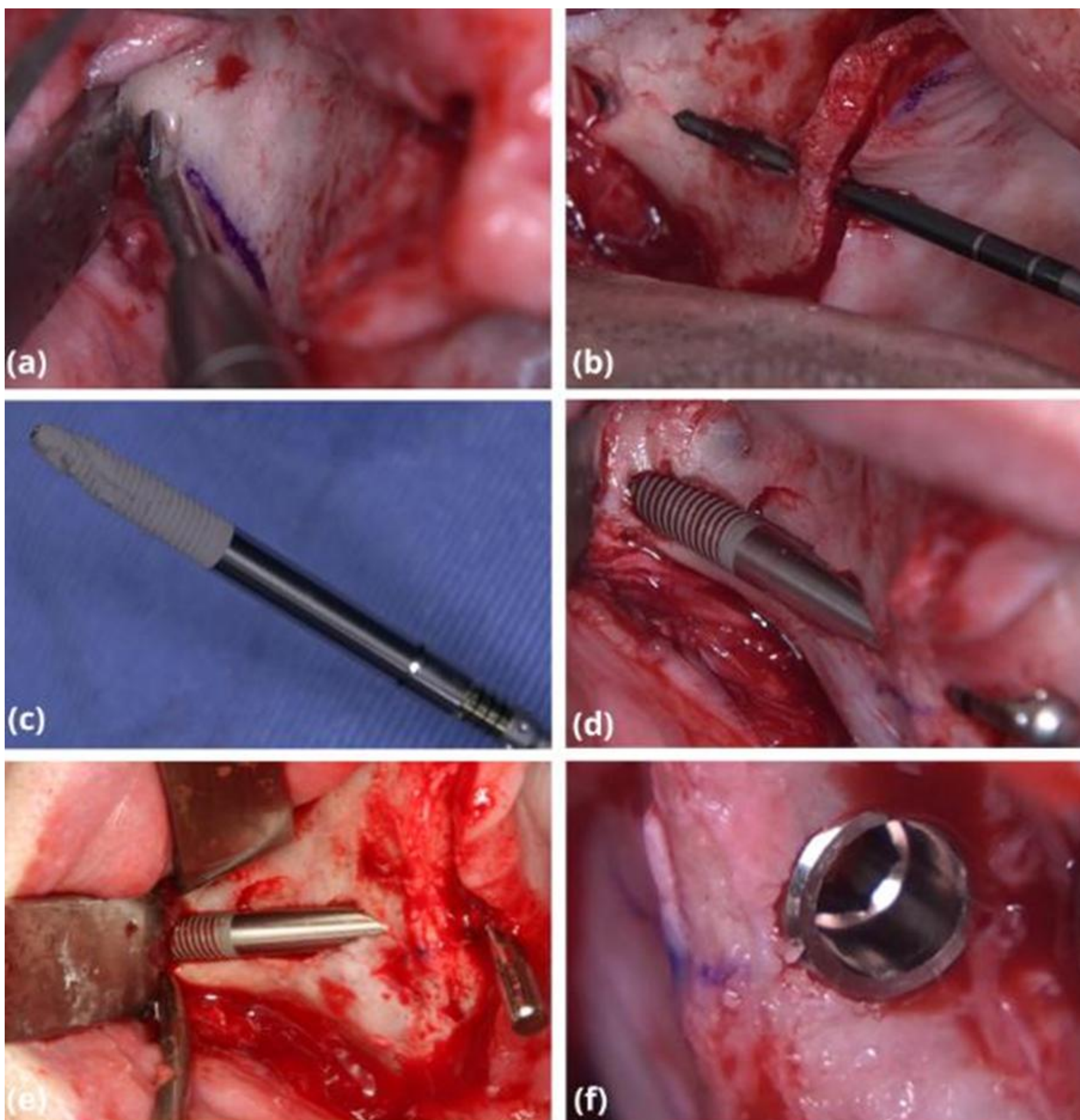

Figure 3 - Surgical procedure -Initial drilling of Zygoma-S implant (a-b). Macrogeometry of the Zygoma-S implant (c). Zygoma-S implant anchored in the zygomatic bone (d-f).

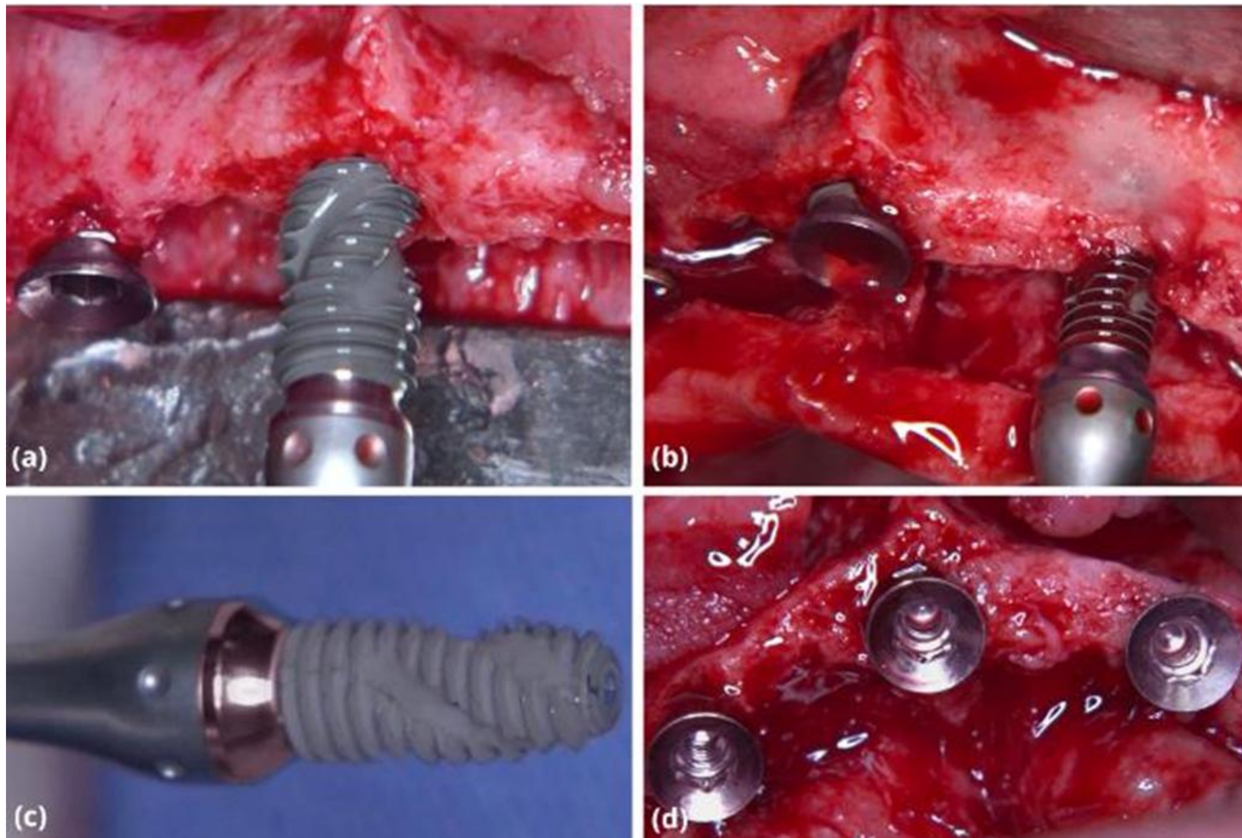

Figure 4 - Surgical procedure - Helix Short implants positioned (a–b). Macrogeometry of the Helix Short implant (c). Occlusal view of the short implants in place (d).

Following the achievement of primary stability for all implants, mini conical abutments were installed. For the zygomatic implants, GM Mini Conical Abutments 60° (Neodent®, Curitiba, Brazil) with 2.5 mm gingival height were used. For the Helix Short implants, HS Mini Conical Abutments (Neodent®, Curitiba, Brazil) with 2.5 mm (region #13), 2.5 mm (nasopalatine region), and 1.5 mm (region #23) gingival height were selected. All abutments were torqued according to the manufacturer's instructions.

Wound closure was achieved using simple sutures. The impression copings for the mini conical abutments were connected to the multifunctional guide using self-curing acrylic resin (Pattern Resin, GC America, IL, USA). The interocclusal record was refined using three reference points of self-curing acrylic resin. After confirming the vertical dimension of occlusion established by the multifunctional guide, the impression material was injected both the interocclusal record and the impression were sent to the dental laboratory to fabricate a full-arch, implant-supported fixed prosthesis. The definitive prosthesis was delivered 48 hours after surgery (Figure 5A-5B). Sutures were removed for seven days postoperatively.

Postoperative Care

Postoperative medication included amoxicillin 875 mg and Spidufem® 600mg. No adverse events were observed during or after surgery.

Follow-Up

The patient was followed up at 1, 6 and 12 months postoperatively, with annual monitoring. Satisfactory function and preservation of peri-implant mucosal health were observed throughout the observation period. Also, radiographic evaluation revealed satisfactory bone stability (Figure 5C-5I).

No mechanical or biological complications were observed during the 4-year follow-up period. All implants and the implant-supported prosthesis remained in function.

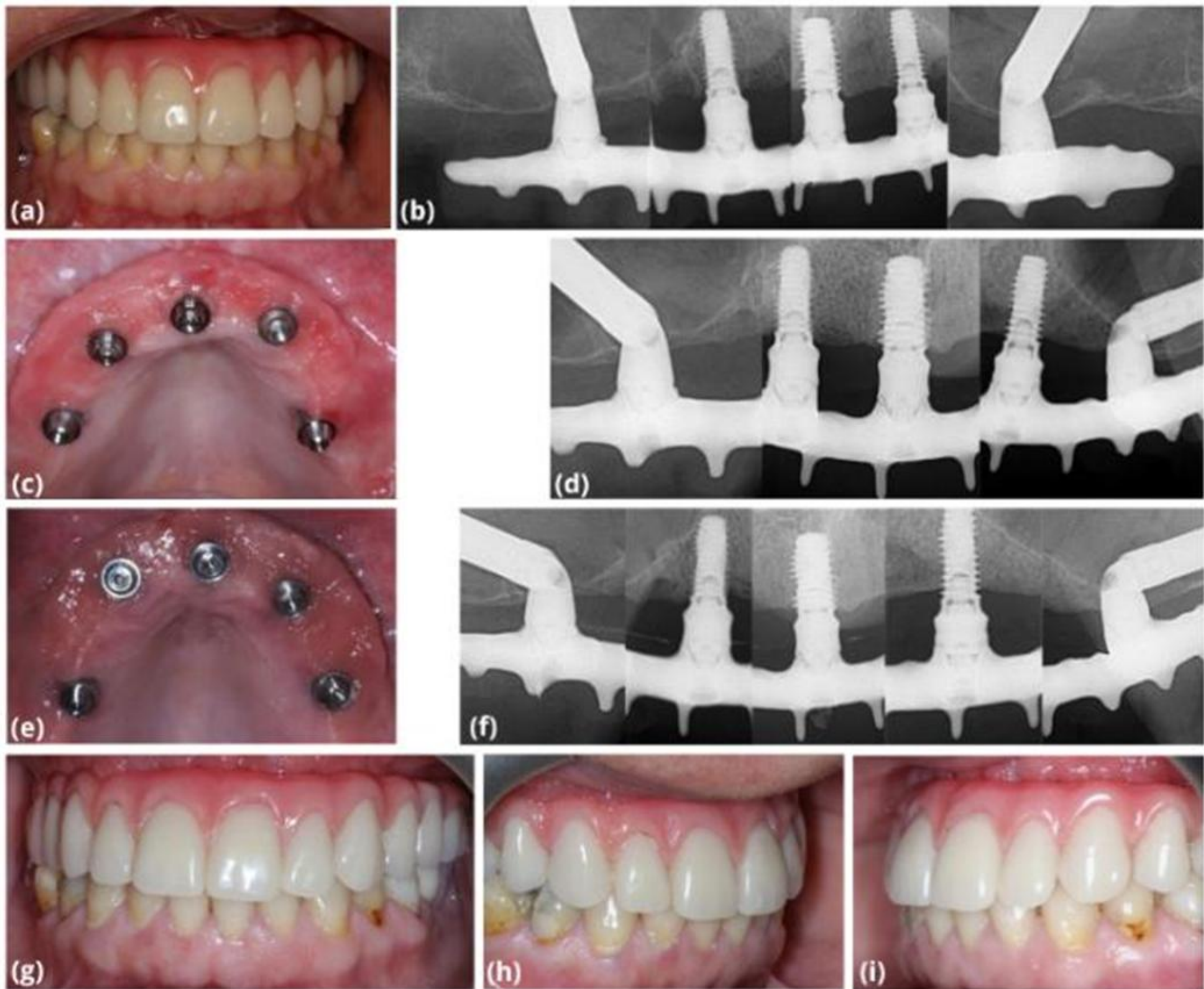

Figure 5 - Clinical and radiographic conditions: Final definitive prosthesis delivered at 48 hours postoperatively. (a–b); 1-year follow-up (c–d); 4-year follow-up (e–i).

Discussion

This case report describes the rehabilitation of atrophic maxilla using remote anchorage with zygomatic implants combined with short implants in the premaxilla. Immediate loading was performed. After a 4-year follow-up period, all implants remained stable and functional, with preservation of peri-implant bone levels. No mechanical or biological complications were observed during the mid-term follow-up. This case report describes the rehabilitation of atrophic maxilla using remote anchorage with zygomatic implants combined with short implants in the premaxilla. Immediate loading was performed. After a 4-year follow-up period, all implants remained stable and functional, with preservation of peri-implant bone levels. No mechanical or biological complications were observed during the mid-term follow-up.

Maxillary atrophy typically requires alternative rehabilitation strategies[20]. Conventional implant placement with sinus floor elevation or bone grafting is a standard approach[22]. However, from a patient perspective, this approach demonstrates increased morbidity and longer recovery time [23]. As a result, techniques that minimize or eliminate the need for bone grafting have gained relevance in the management of severe maxillary atrophy. In this context, alternative strategies such as remote anchorage using zygomatic implants have been proposed[8,24,25].

Remote anchorage provides a predictable treatment option for challenging maxillary defects, particularly in cases where severe bone resorption and extensive sinus pneumatization limit the feasibility of conventional implant placement[24]**.** This technique

consists of engaging distant cortical bone to enhance primary stability and optimize load distribution, particularly in severely atrophic jaws[26]. In addition to surgical advantages, remote anchorage also offers prosthetic benefits, including cantilever reduction and improved anterior–posterior distribution, which contribute to enhanced load transfer and long-term prosthetic stability[26]. These biomechanical characteristics may also support the feasibility of immediate loading protocols, as in addition to primary stability, implant distribution and cross-arch splinting are recognized as important factors for maintaining stability during the early healing phase.

The decision to use zygomatic anchorage in this clinical case was based on the presence of severe posterior maxillary atrophy and bilateral pneumatization of the maxillary sinus[8]. Zygomatic implants have demonstrated high survival rates, exceeding 95%[9,11-14]. In this case report, no implant loss occurred during the mid-term follow-up period. Postoperative sinusitis has been reported as the most common complication associated with zygomatic implants, while soft tissue dehiscence has also been identified as a potential adverse event[11,27,28]. No surgical or prosthetic complications were observed throughout the follow-up period.

Short implants are indicated in the anterior region when atrophic maxilla provides sufficient residual bone for stable placement[20,25]. In the present case, three straight short implants were placed in the premaxilla, including one positioned through a nasopalatine approach. The use of nasopalatine deflation associated with implant placement may be considered in cases of atrophic maxilla, as this anatomical structure may serve as an additional site for implant anchorage and enhance anterior implant support[29,30]. Careful anatomical assessment using CBCT is essential for proper treatment planning, since this region presents anatomical variation in size, morphology, and configuration across individuals and populations[31,32]. Because the nasopalatine canal contains neurovascular structures, implant placement in this region may result in neurosensory disturbances, including transient or permanent sensory alterations[33]. In full-arch rehabilitation, wide-platform implants are indicated in order to improve primary stability and allow immediate loading[34]. A retrospective study examined fifteen edentulous patients who were rehabilitated using zygomatic implants in conjunction with implants placed in the nasopalatine foramen. All patients underwent immediate loading and were followed for 8 years. In this case report, no implant failures or sensory disturbances in the nasopalatine region were observed during the follow-up period[29].

Several studies have demonstrated predictable outcomes when two zygomatic implants are combined with anterior maxillary implants, supporting this configuration as a reliable alternative for the rehabilitation of the atrophic maxilla[9,35,36]. Alternative full-arch rehabilitation protocols have also been proposed for the treatment of atrophic maxilla, such as the All-on-4 concept, which relies on two anterior implants and two posterior tilted. Both treatment approaches have shown favorable surgical and prosthetic outcomes[37]. However, other factors such as patient satisfaction and the incidence of biological complications may differ between treatment modalities [37]. Therefore, the choice between these approaches may depend on clinical experience and patient preference factors.

Zygomatic implant placement is considered technique-sensitive and requires thorough anatomical knowledge and surgical expertise, proper execution is essential to minimize complications and achieve predictable outcomes[38-40]. Similarly, short implants have also been proposed as a less invasive alternative in cases with limited bone height, as they avoid grafting procedures and are associated with fewer biological complications and reduced morbidity compared to standard-length implants placed with sinus floor elevation[2,17].

In this case report, the strategic use of posterior zygomatic implants with short implants in the premaxilla enhanced the anterior–posterior spread and reduced cantilever length, resulting in favorable load distribution and improved prosthetic stability. These findings are supported by literature, which found that higher cantilever/anterior–posterior spread (CL/AP) ratios were associated with an increased frequency of screw loosening and prosthetic complications[41,42].

Conclusion

This clinical case report demonstrates that treatment with remote anchorage using zygomatic implants in combination with short implants in premaxilla represents a strategic approach for the rehabilitation of atrophic maxilla. This protocol allows for a reduction in the number of surgical stages and ensures a mechanically stable prosthetic outcome. After a 4-year follow-up period, all implants demonstrated stability of peri-implant bone level and preservation of peri-implant mucosal health. As this report describes a single clinical case, the findings should be interpreted with caution and cannot be generalized. Further long-

term studies are needed to confirm the predictability of this approach for the rehabilitation of atrophic maxilla.

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