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Guided bone regeneration and guided Straumann TLX implant surgery on anterior maxilla - a case report

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Monografia apresentada a Faculdade ILAPEO como parte dos requisitos para obtenção de título de Especialista0 em Odontologia com área de concentração em Implantologia

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# BANCA EXAMINADORA

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# Acknowledgment

Firstly, I would like to thank God for providing me with the health and strength to pursue this course and travel each month to attend the sessions. His guidance and blessings have been invaluable throughout this journey.

Secondly, my heartfelt gratitude goes to my wife, who has been my pillar of support and motivation. Her unwavering encouragement and ability to manage our household in my absence have been essential to my success in dentistry.

Lastly, I extend my thanks to all the professors and staff who shared their vast knowledge with me. Their dedication and expertise have significantly enhanced my skills and contributed to my professional development.

# **Summary**

1	Scientific Paper	1
	Scientific Paper	a)

# 1. Scientific Paper

This case report is in accordance with the norms of Faculdade ILAPEO

# GUIDED BONE REGENERATION AND GUIDED STRAUMANN TLX IMPLANT SURGERY WITH DIGITAL WORKFLOW ON AESTHETIC AREA - A CASE REPORT

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#### **ABSTRACT**

This case report discusses the clinical decision-making and surgical workflow involved in the rehabilitation of a 39-year-old female patient with congenitally missing and impacted canines, using immediate loading implant protocols in the aesthetic zone. Following unsuccessful orthodontic repositioning, tooth 13 was surgically removed and the site underwent guided bone regeneration (GBR) using Cerabone Plus and Membrane Flex. After an 8-month healing period, Straumann TLX implants were placed in positions 13 and 23 using a fully digital, prosthetically driven workflow. The implants achieved high primary stability (45 Ncm and 80 Ncm respectively), permitting immediate loading. Temporary prostheses were fabricated with carefully contoured emergence profiles to support soft tissue aesthetics. Final prostheses were delivered after 30 days, following digital scanning and tissue conditioning. This report highlights the clinical, radiographic, and prosthetic steps necessary to achieve predictable esthetic outcomes using modern implant systems and digital planning tools in immediate loading protocols. The case reinforces the importance of bone quality assessment, primary stability, and emergence profile design in the esthetic zone for long-term success.

**Keywords**: Dental Implants; Immediate Dental Implant Loading; Guided Implant Surgery; Dental Prosthesis, Implant-supported.

#### INTRODUCTION

In today's fast-paced world, people increasingly seek instant gratification, whether through immediate recognition on social media or swift results from medical treatments. This growing demand for immediacy extends to dentistry, where patients expect rapid outcomes with perfect esthetics. Over the past few years, implant dentistry has seen significant advancements, particularly in immediate loading protocols.

Immediate loading of dental implants offers several advantages, including prosthetically guided soft tissue healing, which helps maintain the pre-extraction site's soft tissue anatomy<sup>1</sup>, as well as shorter healing time compared to traditional loading implants<sup>2</sup>. With advancements on bone substitutes and newly developed implants, designed for immediate loading and prioritize primary stability—such as the BLX and TLX series from Straumann AG (Straumann Holding AG, Basel, Switzerland)<sup>3</sup>—through their specialized thread design.

Beyond meeting the clinical requirements for implant loading protocols, another crucial consideration in the esthetic zone is the design of the prosthesis. Both the White Esthetic Score (WES) and Pink Esthetic Score (PES) demand careful attention to the emergence profile and contours of the provisional prosthesis to ensure optimal aesthetic and functional results<sup>4</sup>.

The use of advanced digital planning software and digital smile design are available to help us achieve a more precise, with a less invasive approach, dental implant placement, leading to faster recovery and fewer adverse events.

The objective of this clinical case report is to demonstrate how advancements in technology, can contribute to achieving predictable esthetics through its application in prosthetically driven implant therapy.

## **CLINICAL CASE REPORT**

Patient G. F. female, 39 years old, presented to ILAPEO (Curitiba, Paraná, Brazil) seeking dental treatment. Patient was missing teeth number 13 and 23. At the time of the initial consult, the patient was undergoing orthodontic treatment.

The patient reported that after several attempts to reposition her upper right canine (tooth 13), which was retained in the palate, via orthodontic treatment. The orthodontist was unsuccessful and referred her to have the tooth removed.

During her initial consultation, a clinical and radiographic examination was conducted, intra and extra oral photographs were taken, as well as a digital intra-oral scan and a CBCT (Cone-Bean Computed Tomography) of her upper and lower jaws.

After reviewing her clinical history, radiographs, and CBCT, we planned for a surgical removal of the retained upper right canine, followed by guided bone regeneration as the first step to have tooth 13 replaced with a dental implant, having both implants (13 and 23) placed at a later stage.

For the removal of tooth 13, 3.4ml of 2% mepivacaine with 1:100,000 epinephrine was administered on buccal and palatal infiltration, it was made a supra-crestal incision at the bone crest between tooth 12 and 14, followed by an intra-sulcular incision around tooth 11, 12 and 14, extending to the papilla of the adjacent tooth. A full thickness flap was then raised and the tissue reflected to expose the retained canine. Bone troughing around the tooth was performed with Zecrya FG bur, the tooth was then luxated and removed with elevators.



Figure 1 – profile photograph



Figure 2 – Initial intra-oral photograph

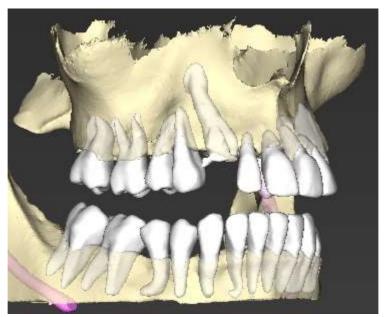


Figure 3 – Impacted upper right canine



Figure 4 – Incision and reflected of flap



Figure 5 – Bone troughing around tooth 13

After the removal of the tooth, we prepared the site for bone guided regeneration (GBR). We opted to use Cerabone Plus (Botiss GmbH, Zossen, Germany), which contains hyaluronate, as bone substitute for its malleability and proven osteoconductivity and long-term volume stability<sup>17</sup>. 1 cc. of bone was mixed with 1 cc. of sterile saline to hydrate the bone. When the bone achieved a gelatinous consistency, it was paced in the socket and covered with Membrane Flex (Straumann Holding AG, Basel, Switzerland), which is made of highly purified intact porcine peritoneum, providing biomechanical strength and predictable and controlled resorption (3-4 months) according to the manufacture<sup>18</sup>. The surgical site was then sutured with 4-0 Nylon Soft Blue suture (Techsuture, Bauru, Brazil). The patient was seen 15 days after the surgery for follow-up and suture removal.



Figure 6 – Bone defect after canine extraction



Figure 7 – Membrane Flex (Straumann Holding AG, Basel, Switzerland) being placed



Figure 8 - Cerabone Plus (Botiss GmbH, Zossen, Germany) being placed in socket



Figure 9 – Membrane Flex (Straumann Holding AG, Basel, Switzerland) positioned before sutures



Figure 10 – Sutures placed

A period of 8-months healing time was given to the extraction and bone graft site before implant placement. A new CBCT was then requested for implant planning.

We begun the implant planning with a prosthetically driven approach. The mouth was scanned with the Straumann Sirios intra-oral scanner (Straumann Holding AG, Basel, Switzerland). The provisional crown was designed utilizing SmileCloud 3DNA Software (SmileCloud, Romania). The STL files of the provisional crowns were then exported and imported into the implant planning software coDiagnostiX (Dental Wings GmbH, Chemnitz, Germany), where the final positioning of the implants and surgical guide was planned.

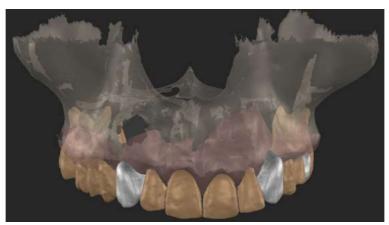


Figure 11 – Provisional design on SmileCloud 3DNA



Figure 12 – Digital wax-up of provisionals imported into coDiagnostiX

For the implant site 13, there was available space of 14.8mm vertically, 9.0mm buccallingually, and 7.4mm of interdental space. The implant of choice was a Straumann TLX (Straumann Holding AG, Basel, Switzerland) 4.5 x 12mm for the 13 site. For the implant site 23, there was available space of 14.6mm vertically, 6.5mm buccal-lingually, and 8.0mm of interdental space. The implant of choice was a Straumann TLX (Straumann Holding AG, Basel, Switzerland) 3.75 x 12mm.

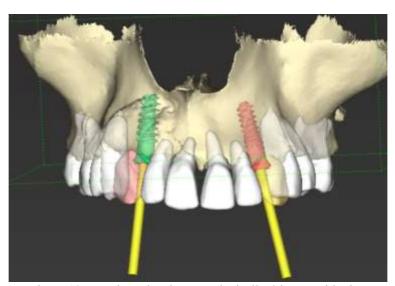


Figure 13 – Implant planning, prosthetically driven positioning

A surgical guide was designed on the implant planning software coDiagnostiX and printed with a Phrozen Sonic Mini 8K 3d printer (Phrozen Tech Co. Ltd, Hsinchu City,

Taiwan). It was also designed and printed an index to position and capture the temporary abutments.

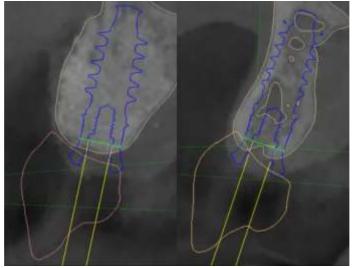


Figure 14 – Cross sectional positioning of implant 13 (left) and 23 (right)

Eight months after the removal of the retained canine 13, the patient returns for a second surgery, to place implants on 13 and 23 sites.

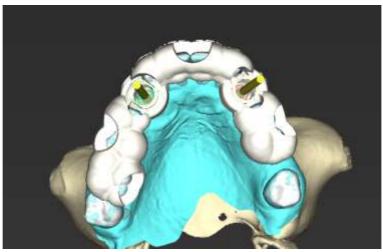


Figure 15 – Surgical guide planning on coDiagnostix





Figure 16 A and B – Surgical guide for implant placement



Figure 17 – Provisional index for provisional implant prothesis capture

At the day of the surgery, it was given to her 4mg of Dexametasone and 2mg of Diazepan one hour before the appointment. The patient was then brought to the surgical center,

the surgical guide and provisional index were tried-in and adjustments were made as necessary. Topical local anesthetic was placed with a cotton swab, 3.4ml of 2% Mepivacaine 1:100,000 epinephrin was administered on buccal and palatal infiltration around 13 and 3.4ml of 2% Mepivacaine 1:100,000 epinephrin was injected on buccal and palatal infiltration around 23.

For the implant placement a Straumann surgical motor and contra-angle (Straumann Holding AG, Basel, Switzerland) was used. For cooling of the drills, we used refrigerated saline at 5 degrees Celsius. The drilling sequence was started according to the surgical protocol stablished by the coDiagnostiX software and recommended by the manufacturer. This software calculates the surgical protocol based on the virtual planning of implant placement and choice of T-sleeve type and position, height. The recommended drills Ø and color code make it easier for the operator to identify the drill, and the required combination of cylinder height off set (dots, each dot corresponds to 1 mm) and drill length (set by lines), in this case three lines indicate long drills (24 mm guided length) and three dots indicated an off set of 3 mm.

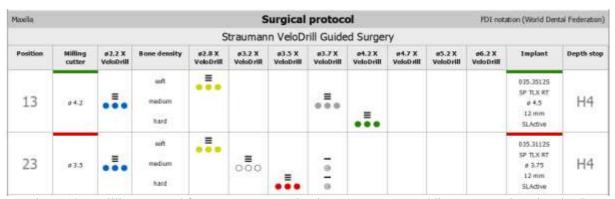


Figure 18 – Drilling protocol for Straumann TLX implants (Straumann Holding AG, Basel, Switzerland)

It is of most importance to determine the bone density. If the wrong bone density is identified, it might be challenging to achieve adequate primary stability and therefore, success of immediate loading prosthesis.

The surgical guide was placed in place. A flapless approach was chosen, a mucosal punch was made through the 5.0 mm T-sleeve using the Ø 4.7 mm guided Mucosa Punch drill

at 15 rpm on both sites. The first drill used for 13 site was the Milling cutter Ø 4.2 mm at 400 rpm at H4 height. The bone density in this case was identified as Soft/Medium. Next, it was followed by the 3 dots cylinder handle and VeloDrill<sup>TM</sup>, guided Ø 2.8 mm with 3 lines at 600 rpm (it is recommended that all VeloDrill<sup>TM</sup>, guided be used at maximum 800 rpm), followed by 3 dots cylinder handle and VeloDrill<sup>TM</sup>, guided Ø 3.7 mm with 3 lines at 600 rpm. The implant was placed through the surgical guide with a speed of 15 rpm and 30 N.cm. The 13 implant had a primary stability of 45 N.cm.

We them moved to site 23 and started the drilling sequence. The first drill used was as the Milling cutter Ø 3.5 mm at 400 rpm at H4 height. The bone density in this case was identified as Soft/Medium. Next, it was followed by 3 dots cylinder handle and VeloDrill™, guided Ø 2.8 mm with 3 lines at 600 rpm, followed by 3 dots cylinder handle and VeloDrill™, guided Ø 3.2 mm with 3 lines at 600 rpm. The implant was placed through the surgical guide with a speed of 15 rpm and 30 N.cm. The implant 23 has a primary stability of 80 N.cm.



Figure 19 – Surgical guide

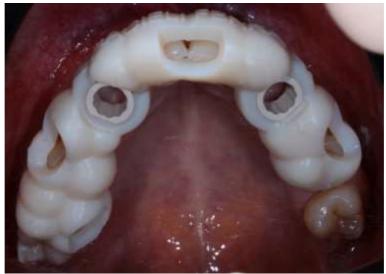


Figure 20 – Surgical guide seated

With such primary stability, both implants were capable of supporting provisional prosthesis with immediate loading.



Figure 21 – Flapless surgical access



Figure 22 – Implant TLX 4.5x12mm



Figure 23 – Implant TLX being placed through the surgical guide



Figure 24 – Implants placed

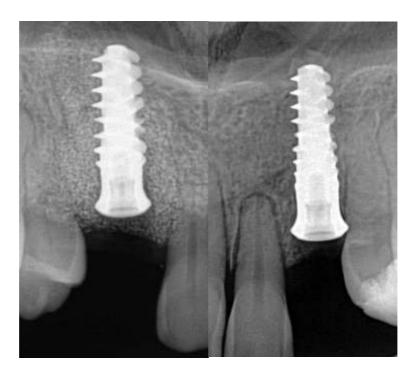


Figure 25 – Periapical radiographs of Implant 13 (left), implant 23 (right)

A periapical x-ray was taken to verify the implant position. A temporary RT abutment was secured in the implants, and the provisional index was seated for us to capture the abutments. Once the provisional crowns were seated at the correct position, flowable composite resin was injected around the abutment with the purpose of affixing the provisional crowns to the temporary abutment. The temporary abutments were then removed with the provisional prosthesis attached to them. As a second step, flowable composite resin was added in the transition zone with the purpose of forming the submucosal emergence profile. The emergence profile was then designed, trimmed and polished to precisely contour the soft tissue.



Figure 26 – Provisional prosthetic index



Figure 27 – Provisional prosthesis

For post operatory medication, it was prescribed Spidufen 600 mg P.O. (Ibuprofen Arginate) q4-6h P.R.N for 5 days, Amoxicillin 500 mg T.I.D for 7 days, and Dipirona 500 mg (Metamizole) q4-6h P.R.N.

According to the manufacture, the required healing period for the Straumann TLX SLActive (Straumann Holding AG, Basel, Switzerland) implant in healed sites is 21 days. We waited 30 days until the next visit. At this visit the emergence profile of the soft tissue was scanned immediately after removal of the provisional prosthesis with the Sirios intra-oral scanner (Straumann Holding AG, Basel, Switzerland), a scan body RT was secured to the implant and scanned. After the scan was completed, the provisional prosthesis was placed back in the implant and hand tightened.



Figure 28 – Emergence profile



Figure 29 – Emergence profile implant 23



Figure 30 – Emergence profile implant 13

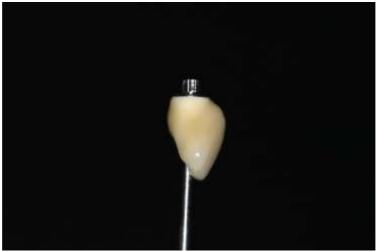


Figure 31 – Final crown emergence profile



Figure 32 – Crown 23 being inserted



Figure 33 – Crown 13 being inserted

Four weeks later, the provisional prosthesis were removed, the final prosthesis was placed and tightened to 35 N.cm, a periapical x-ray was taken to verify fit, bite and contacts were verified. The screw access was sealed with Teflon take and composite resin.



Figure 34 – Smile with new crowns



Figure 35 – Close-up smile



Figure 36 – Intra-oral close-up smile



Figure 37 – 13 crown close up – 30 days follow-up



Figure 38 – 23 crown close up – 30 days follow-up

### **DISCUSSION**

Congenitally missing canines or impaction of these teeth can create challenges for an esthetically pleasing outcome in general. In same cases, orthodontic treatment can be done by replacing the missing canine with the first premolar<sup>5</sup>. In other cases, dental implants can be used to replaced missing canines<sup>6</sup>.

In this case, correcting the space of the missing canines with orthodontics alone, would be extremely challenging as the movement necessary would create more posterior space, which would require dental implants to close the edentulous spaces generated by the orthodontic movement of the premolars.

Throughout dental implantology history, timing for implant placement has been a critical factor. There are three types of protocols for implant placement, they vary according to the timing of the placement of the implant from when the individual lost the tooth. It can be classified as *Late implant placement* (placement after at least 6 months of healing time), *Early implant placement* (placement after at least 4-8 weeks of healing time), and *Immediate implant placement* (placement immediately after tooth extraction).<sup>7</sup>

		L	oading protocol	
			Early Loading (Type	
		Immediate Restoration/Loading (Type A)	B)	Conventional Loading (Type C)
	Immediate Placement (Type 1)	Type 1A	Type 1B	Type 1C
Implant Placement	Early Placement (Type 2–3)	Type 2–3A	Type 2–3B	Type 2–3C
Protocol	Late Placement (Type 4)	Type 4A	Type 4B	Type 4C

Table 1 – Implant placement and loading protocol according to the ITI consensus 14

In the case reported in this paper, we performed a *Late implant placement* as it as placed more than six months after the extraction of tooth 13 and immediate loading. According to the 6<sup>th</sup> ITI Consensus Conference<sup>8</sup>, a late placement with immediate restoration is a scientific and clinically proven technique, with a survival rate of 98%.

An analysis of the esthetic risk assessment<sup>4</sup> was performed. The level of risk was classified as Low, the patient is non-smoker, has a low display of gingiva at full smile, a low-scalloped and thick gingival phenotype, and no bone deficiency at the alveolar crest.

The incorporation of digital tools into implant dentistry has reshaped clinical decision-making by increasing procedural accuracy, minimizing human error, and enabling greater integration between planning and execution. Software such as coDiagnostiX (Dental Wings GmbH, Chemnitz, Germany) and SmileCloud (SmileCloud, Romania) provide a platform for clinicians to integrate CBCT imaging with intraoral scans and esthetic design principles, resulting in a comprehensive, prosthetically driven plan that can be translated with high fidelity into the clinical environment<sup>9</sup>.

The use of a digital workflow combined with advanced technology, such as artificial intelligence and digital smile design supported by artificial intelligence, can drastically improve the esthetic outcome and increase patient satisfaction as well as precision on implant 3D positioning<sup>10</sup>.

One of the primary advantages of these tools lies in their ability to create predictability from the initial stages of treatment. The visualization of the prosthetic outcome prior to surgery enables dentists to reverse-engineer implant positioning based on the final esthetic and functional goals, as well as increasing patient treatment acceptance. As highlighted by Mangano<sup>11</sup>, this approach minimizes intraoperative improvisation and allows for greater interdisciplinary coordination. The ideal positioning of an implant on esthetic area can lead to better contour and positioning of the gingival zenith, playing a critical role in dental esthetics<sup>12</sup>.

In the present case, the patient underwent guided surgery with the placement of a tissue-level implant in the esthetic zone, using a fully digital protocol. By integrating digital smile design with CBCT-based planning, the ideal three-dimensional implant position was determined based on the desired prosthetic emergence profile. This methodology supports both esthetic predictability and biological stability, in line with the recommendations by Testori <sup>13</sup>.

Customized temporary restorations were fabricated to guide the soft tissue architecture, aiding in the development of a natural emergence profile. Studies by González-Martín<sup>14</sup> reinforce the importance of managing the critical and subcritical contours of peri-implant tissues to support esthetic long-term outcomes.

However, as emphasized by Dioguardi<sup>15</sup>, digital protocols are not exempt from risks or challenges. Factors such as guide misfit, inaccuracies in data merging, and operator inexperience can lead to deviations in implant positioning as well as impossibility of using the drill due to limited mouth opening, can lead to surgical failure.

Long-term maintenance remains an essential component of treatment success. Periimplant health depends not only on accurate surgical and prosthetic execution, but also on patient compliance with hygiene and recall visits. As demonstrated by Rokaya<sup>16</sup>, biofilm accumulation remains a leading risk factor for peri-implantitis, highlighting the need for effective patient education and follow-up.

Ultimately, the present case illustrates how digital planning, surgical precision, choice of the right material for bone regeneration and its execution, along with immediate provisionalization can be effectively integrated to deliver esthetic and functional success. The

clinician's ability to navigate these tools with accuracy and intent contributes to the creation of streamlined, patient-centered outcomes grounded in contemporary evidence and best practices.

### **CONCLUSION**

The management of congenitally missing canines or impacted teeth presents unique challenges in achieving optimal esthetic and functional outcomes. While orthodontic approaches may offer solutions in some cases, implant dentistry remains a key tool for restoring missing canines effectively. This case study highlights the complexities of treatment planning, emphasizing the importance of carefully selecting implant placement protocols to ensure long-term success and the best esthetic as possible.

Ultimately, this case underscores the importance of integrating digital planning, surgical precision, the use of advanced bone substitute (Cerabone Plus) to preserve bone and soft tissue volume, and immediate provisionalization (facilitated by the design of the Straumann TLX implant), considering PES and WES to achieve esthetic and functional excellence. As technology continues to evolve, its role in implant dentistry will likely expand, further refining treatment protocols and improving patient-centered outcomes based on contemporary evidence and best practices.

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# Correções:

Titulo: corrigir

Digital planning and guiding in aesthetics zones

Aesthetic zone rehabilitating with full digital workflow

Introducao: foco melhor na parte do PEZ WEZ

Objetivo claro do trabalho, ultima frase na introdução

Duvidas para discutir na discussão

Planejamento: discussão na diferença do protoloco entre alvéolo regenerado vs do 23

Possível pela superfície do implante?

Foco da cirurgia, carga imediata, cirurgia guiada, superfície do implante, planejamento digital

Mais clareza

Poder incluir tabela e discussão da cargas

Diminuir a conclusão

Dalton:

Titulo: regeneração

Sumário

Introdução mais robusta apesar de estar no tamanho correto

Dente 13 raiox refazer raiox

Figuras do timing: não copiar e colar, refaz o quadro

Remover o quadro do timing na discussão.

Conclusão: remover o segundo terceiro e quarto paragrafo,

intra e extra orais, assim como modelos e da	lização pelo aluno, professor da Faculdade ILAPEO e/ou terceiros de minhas imagens ados relativos ao meu tratamento para as finalidades de Publicação em revista cienti- ressos científicos e exposição em aulas e seminários com a finalidade de aprendizado
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