

# **INSTITUTO UNIVERSITÁRIO EGAS MONIZ**

## **MESTRADO INTEGRADO EM MEDICINA DENTÁRIA**

### **EVALUATION OF POST-OPERATIVE PAIN IN PATIENTS SUBMITTED TO PERIODONTAL SURGICAL TREATMENTS USING THE VISUAL ANALOGUE SCALE**

Trabalho submetido por  
**Maaria Khan Domun**  
para a obtenção do grau de Mestre em Medicina Dentária

**setembro de 2025**



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**Prof. Doutor José Maria Cardoso**

**setembro de 2025**



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## **RESUMO**

**Objetivo:** O estudo teve como objetivo avaliar o nível de dor e a influência de vários fatores após o tratamento cirúrgico periodontal, através de uma escala visual analógica (EVA).

**Materiais e Métodos:** Foram recrutados 80 doentes encaminhados para o Departamento de Periodontologia da Clínica Dentária Egas Moniz que necessitavam de tratamento cirúrgico periodontal.

Os dados foram recolhidos através do preenchimento de dois questionários. O primeiro questionário, composto por duas partes, foi preenchido pelo investigador. A primeira parte foi preenchida no dia do procedimento para recolha de dados sobre o historial clínico e a intervenção cirúrgica, e a segunda parte no dia da remoção dos pontos, referente à adesão às instruções de cuidados pós-operatórios. O segundo questionário foi entregue ao doente no dia da cirurgia, juntamente com oito escalas visuais analógicas (EVA). O doente foi instruído para preencher estas escalas três vezes por dia (manhã, tarde e noite) durante os três dias subsequentes à operação e no dia da remoção dos pontos. Este questionário deveria ser devolvido ao investigador no próprio dia. Todas as medições da EVA foram realizadas pelo investigador utilizando a mesma régua.

**Resultados:** De todos os elementos examinados, apenas o género apresentou associação significativa com a dor na primeira noite. As mulheres relataram pontuações de EVA mais elevadas do que os homens ( $p = 0,014$ ). Não se verificou correlação significativa na terceira noite para nenhuma das variáveis testadas. No geral, houve uma redução significativa da dor entre os dias 1 e 3, com uma pontuação mediana da dor de 3 e 1 (numa escala de 0 a 10), respetivamente. O período de dor pós-cirúrgica foi breve.

**Conclusão:** Este tipo de procedimentos cirúrgicos tem pouco impacto na qualidade de vida dos doentes, pelos reduzidos níveis de dor observados no período pós-operatório. Por outro lado, verificou-se que as mulheres podem ter maior intensidade de dor após estes tratamentos, evidenciando a importância de protocolos de tratamento individualizados.

**Palavras-Chaves:** Cirurgia periodontal; Dor; Periodontite; Escala Visual Analógica



## **ABSTRACT**

**Objective:** The study aimed to assess pain levels and the influence of various factors after periodontal surgical treatment using a visual analog scale (VAS).

**Materials and Methods:** 80 patients referred to the Periodontology Department of the Egas Moniz Dental Clinic and requiring periodontal surgical treatment were recruited.

Data was collected by completing two questionnaires. The first, composed of two parts, was completed by the researcher. The first part was completed on the day of the procedure to collect data on medical history and the surgical intervention, and the second part on the day of suture removal, concerning adherence to postoperative care instructions. The second questionnaire was given to the patient on the day of surgery, along with eight visual analog scales (VAS). The patient was asked to complete these scales three times a day (morning, afternoon, and evening) for the three days following the operation and on the day of suture removal. This questionnaire was to be returned to the researcher on that same day. All VAS measurements were performed by the researcher using the same ruler.

**Results:** Of all the elements examined, only sex showed a significant association with pain on the first evening. Women reported higher VAS scores than men ( $p = 0.014$ ). No significant correlation was noted on the third evening for any of the variables tested. Overall, there was a substantial decrease in pain between days 1 and 3, with a median pain score of 3 and 1 (on a scale of 0 to 10), respectively. The post-surgical pain period was brief.

**Conclusion:** This type of surgical procedure has little impact on patients' quality of life, due to the reduced pain levels observed in the postoperative period. On the other hand, it was found that women may experience greater pain intensity after these treatments, highlighting the importance of individualized treatment protocols.

**Keywords:** Periodontal surgery; Pain; Periodontitis; Visual Analog Scale



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## Acronym List

**ASICs** – Acid-Sensitive Ion Channels

**ATP** – Adenosine Triphosphate

**BCT** – Buried Connective Tissue

**B. Forsythus** – Bacteroides Forsythus

**CAF** – Coronally Positioned Flap

**CEJ** – Cementoenamel Junction

**CGRP** – Calcitonin Gene-Related Peptide

**COX** – CycloOxygenase

**CRP** – C-reactive Protein

**D** - Day

**EMDPs** – Enamel Matrix Derived Proteins

**FGG** – Free Gingival Graft

**GI** – Gingival Index

**GTR** – Guided Tissue Regeneration

**HIV** – Human Immunodeficiency Virus

**IASP** – International Association for the Study of Pain

**IL** – Interleukine

**IMPEDE** – Inflammatory-Mediated Polymicrobial-Emergence and Dysbiotic-Exacerbation

**LPS** – Lipopolysaccharide

**MMP** – Matrix Metalloproteinase

**Nav1.7** – Sodium Voltage-gated 1.7

**NGF** – Nerve Grow Factor

**NSAIDs** – Nonsteroidal Anti-Inflammatory Drugs

**OPG** – Osteoprotegerin

**P. Gingivalis** – Porphyromonas Gingivalis

**PI** – Plaque Index

**PMNs** – Polymorphonuclear Neutrophils

**RANK** – Receptor Activator of Nuclear factor k8

**RANKL** – Receptor Activator of Nuclear factor k8 Ligand

**ROS/RNS** – Reactive Oxygen and Nitrogen Species

**S. Salivarius** – Streptococcus Salivarius

**S. Sanguis** – Streptococcus Sanguis

**SCN9A** – Sodium Channel, Voltage-gated, Type IX

**T. Denticola** – Treponema Denticola

**TLR4** – Toll-Like Receptor 4

**TNF** – Tumor Necrosis Factor

**TRP** – Transient Receptor Potential

**TRPA1** – Transient Receptor Potential Ankyrin 1  
**TRPM8** – Transient Receptor Potential Melastatin 1  
**TRPV1** – Transient Receptor Potential Vanilloid 1  
**V1** – Ophthalmic branch of the Trigeminal Nerve  
**V2** – Maxilar branch of the Trigeminal Nerve  
**V3** – Mandibular branch of the Trigeminal Nerve  
**VAS** – Visual Analog Scale

## **I. INTRODUCTION**

“Periodontal disease is one of the most common inflammatory diseases in adults” (Bui et al., 2018). In 2021, more than 1 billion people worldwide suffered from a severe form of periodontitis, and this figure could vary according to estimates between 9 and 12 in 100 people (Nascimento et al., 2024).

Periodontology is a specialty of dentistry dedicated to the prevention, diagnosis, and treatment of diseases affecting the supporting tissues of the teeth: the gums, periodontal ligament, cementum, and alveolar bone (Kumar, 2024).

The main etiological agents of this disease are dental plaque microorganisms. They manifest themselves in the form of biofilms. These are bacterial pathogens that are located in subgingival biofilms (Mailoa et al., 2015).

Periodontal diseases are commonly classified as gingivitis and periodontitis. Gingivitis is an inflammatory response of the gingival tissues to the native subgingival microbiota. It occurs when a local imbalance in the gingival microenvironment leads to tissue inflammation, without causing attachment loss or bone destruction. At this stage, the bacterial flora remains primarily commensal, although disruptions can promote the development of dysbiosis (Lang & Bartold, 2018).

Periodontitis is a chronic inflammatory disease resulting from the progression of gingivitis. It is characterised by an exacerbated inflammatory response of the host, associated with a change in the subgingival bacterial composition towards more virulent species. This dysbiosis promotes a progressive destruction of the tooth's supporting tissues, notably the periodontal ligament and alveolar bone. It therefore involves both microbial factors and an unbalanced immune response (Deng et al., 2017).

Periodontal treatment is based on a progressive and individualised approach, aimed at controlling the infection and stabilising the disease (Laforgia et al., 2024). The success depends on its ability to decrease the concentration of the pathological biofilms and on the restoration of a biologically acceptable root surface (Mailoa et al., 2015).

Manual instrumentation for subgingival scaling usually results in a change in the microbial flora. It generally helps reduce the number of Gram-negative bacteria while

stimulating the growth of Gram-positive bacteria, such as cocci and bacilli. This transition to a flora predominantly composed of Gram-positive bacteria is generally associated with improved gingival health (Cobb, 2002). Subgingival scaling combined with rigorous improvement of dental hygiene is the first step to reduce the gingival inflammation and the depth of periodontal pockets (Laforgia et al., 2024).

In some cases, non-surgical treatments are not sufficient, such as in the presence of extensive periodontal pockets or large bone defects. A surgical phase may then be necessary (Heitz-Mayfield & Lang, 2013). Periodontal surgical treatments allow optimal access to infected root surfaces in order to perform an adequate debridement. Their objectives are to reduce deep periodontal pockets, restore favourable bone morphology, regenerate lost tissue and establish optimal gingival contours for self-performed plaque control (Lang & Bartold, 2018). These procedures include, among others, access operations, resective interventions, regenerative and plastic surgeries, which can be performed with or without the use of biomaterials. These treatments promote an oral environment favourable to tissue regeneration and microbial flora balance and aim to reduce the likelihood of disease recurrence (Laforgia et al., 2024).

Although these procedures are commonly performed and generally well tolerated, they are inevitably accompanied by a postoperative inflammatory response, the most common manifestations of which are pain, swelling and discomfort (Sodhi et al., 2021).

The International Association of the Study of Pain defined pain as “an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage” (“IASP Announces,” 2020). Pain assessment is a complex process, likely to be affected by factors such as age, sex, smoking habits, and medical conditions (Gufran et al., 2023).

The pain, usually acute and temporary, can appear immediately after the end of local anaesthesia and persist for several days. It is often linked to other clinical manifestations such as oedema, difficulty chewing or speaking, or even a slight deterioration in general condition (Pippi, 2017). This pain can elicit emotional responses that affect the patient's well-being and motivation to follow treatment, thus compromising the stabilisation of

periodontal disease. It is therefore essential to understand the patient's pain level and the factors that can modify it (Gufran et al., 2023).

Control strategies used in clinical practice include the use of medications, such as analgesics and nonsteroidal anti-inflammatory drugs, as well as education on habits to change in the days following surgery (Zghab et al., 2024).

*Evaluation of Post-Operative Pain in Patients Submitted to Periodontal Surgical Treatments Using the Visual Analogue Scale*

## II. LITERATURE REVIEW

### 1. Pain

The International Association for the Study of Pain (IASP) presented an updated definition of pain in 2020, along with six key points that highlight its complexity. To begin, pain is characterised as an individual experience that differs from one person to another. A person's perception of pain is therefore greatly influenced by their past experiences. This is how they learn the concept of pain. This definition also speaks of the importance of respecting others' perceptions of pain. Furthermore, while pain generally has an adaptive function, it can also have deleterious effects on functional, social, and psychological levels. The IASP also highlights that the inability to communicate does not mean there is no pain. There are other means of communication besides speech. Finally, it is important to distinguish between pain and nociception (Klasser & Reyes, 2023). Pain is a complex phenomenon with sensory, emotional, and cognitive components, while nociception refers to the activity of sensory neurons due to tissue damage. This activity alone is not sufficient to confirm the presence of pain (Klasser & Reyes, 2023).

#### 1.1. Classification of pain

Pain can be classified according to its underlying mechanisms into nociceptive, inflammatory, and neuropathic (Figure 1) (Woolf, 2010).

##### Nociceptive Pain

Nociceptive pain is the most frequently encountered form of pain in clinical practice, particularly after surgery. Its function is to indicate imminent or already caused tissue damage by environmental factors (Woolf, 2010). This type of pain is a response to intense stimuli, such as burns, shock, cuts, or irritating chemicals (Woolf & Ma, 2007; Woolf, 2004). It plays an adaptive and protective role and serves as a biological warning system, producing a withdrawal reflex. Nociceptive pain is perceived as something to be immediately avoided, and when it occurs, it inhibits most other neuronal functions (Woolf, 2010).

### Inflammatory Pain

Inflammatory pain plays a crucial defensive role by signalling threats to the body. It aids healing by increasing sensitivity after tissue injury (Ferran, 2018; Woolf, 2004). It emerges from a two-way interaction between the neurosensory and immune systems, where inflammation increases the sensitivity of nociceptors and affects pain propagation. This pain prevents touch and movement, thus facilitating healing of the injured body area (Bertin & Vergne-Salle, 2019) (Woolf, 2010). Furthermore, pain triggers a succession of responses, ranging from the initial injury to the full inflammatory reaction, involving various mediators and cells (Karateev et al., 2017). Although inflammatory pain plays a protective role, it can become problematic if it persists, requiring appropriate treatment (Bertin & Vergne-Salle, 2019).

### Neuropathic Pain

Pathological pain results from a malfunction of the nervous system. This category of pain includes neuropathic and dysfunctional pain (Woolf, 2010; Woolf, 2004). Neuropathic pain occurs following an injury to the nervous system, while dysfunctional pain occurs without any observed injury or inflammation (Woolf, 2004).

Pathological pain is caused by an increase in sensory signals in the central nervous system and represents mild pain (Woolf, 2010). It causes sensitisation and neuroplastic changes in the central nervous system. These changes can lead to chronic pain (Latremoliere & Woolf, 2009).

Neuropathic pain is often synonymous with symptoms such as burning sensations and electric shocks. The persistent ineffectiveness of analgesics and their poor response cause significant health problems for patients, who often face psychiatric disorders such as depression, anxiety, and insomnia (Cao et al., 2024).

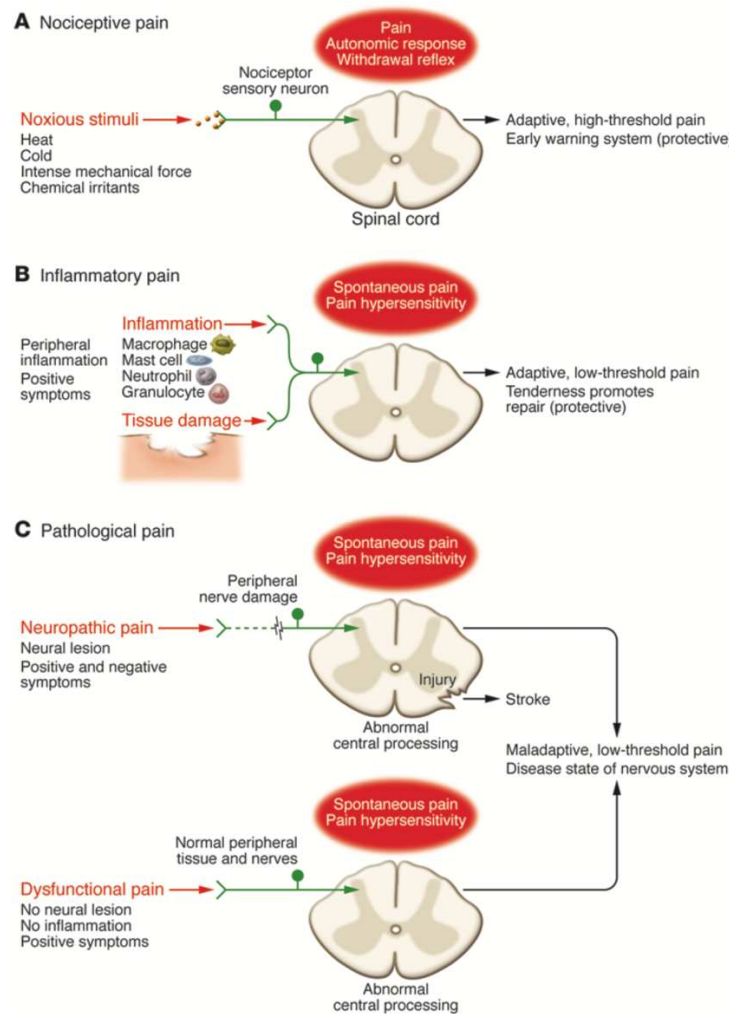


Figure 1- The different types of pain, repinted from Woolf, 2010

## 1.2. Neurons

Neurons are specialised cells of the nervous system. They constitute the structural and functional unit of the brain and spinal cord (Césaro, 2008). They are responsible for receiving, transmitting, and processing electrical and chemical signals (Hall & Hall, 2021).

It is estimated that the central nervous system contains 80 to 100 billion neurons (Hall & Hall, 2021).

The path of the nociceptive impulse from peripheral tissues to its metamorphosis in the cerebral cortex during pain perception can be observed through a series of neurons. This would be more accurately described as a network of pathways, with crossings and traffic lights (Klasser & Reyes, 2023).

Pain information begins with a painful stimulus in peripheral tissues, followed by the activation of nociceptors. The signal is then passed through peripheral nerve fibers to the dorsal horn of the spinal cord. There, it passes to another neuron through a synapse. This second neuron crosses the midline to the contralateral side of the spinal cord before ascending through the spinothalamic tract to the thalamus. There a third neuron relays the information to different cortical regions. The information is then integrated in the cerebral cortex (Figure 2) (Klasser & Reyes, 2023).

The neuron is composed of three major elements: the soma, which constitutes the cell body, as well as the dendrites and the axon. Grey matter is defined by the presence of cell bodies, while the extensions of myelinated axons constitute the white matter. The unique membranes of this functional unit of the nervous system give it the ability to integrate hundreds, even thousands, of messages (Césaro, 2008).

Signals pass through synapses located on the dendrites or the cell body to enter the neuron. Depending on the type of neuron, we can observe anywhere from a few hundred to 200,000 such synaptic connections originating from the input fibers. The signals then exit via a single axon to leave the neuron. But this axon can have many different branches that go to various parts of the nervous system or the peripheral body (Hall & Hall, 2021). The diffusion of nervous information occurs through an action potential. This is an electrical signal produced by fluctuations in ion concentrations on either side of the neuronal membrane. This signal, which propagates along the axon, is transformed into a chemical signal when neurotransmitters are released. These neurotransmitters pass through the synaptic cleft to bind to receptors on the next neuron, thereby propagating the signal (Sakmann, 1992).

Generally, information only travels forward, from the axon of the previous neuron to the dendrites of the cell membranes of subsequent neurons. Thus, the signal can perform specific nervous functions (Hall & Hall, 2021).

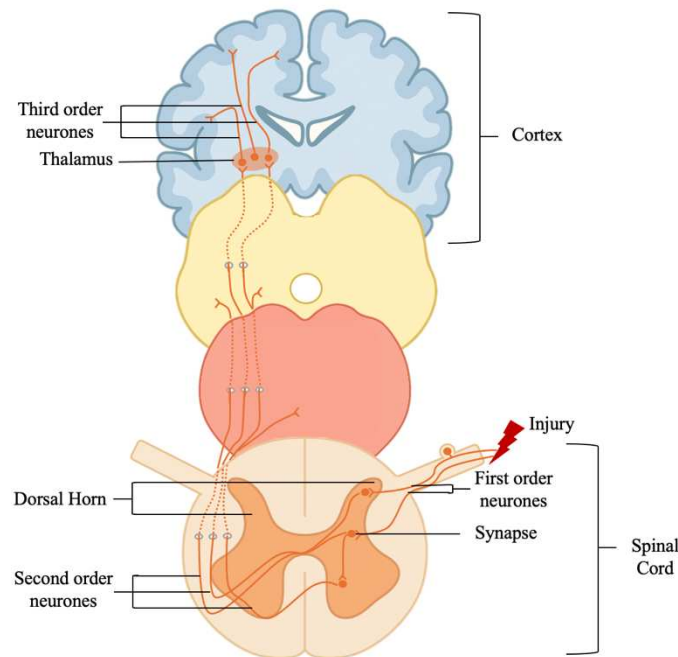


Figure 2 - Path of the nociceptive impulse, adapted from Fields, 2024

### 1.3.Pain at Cellular Level

Pain is triggered by the activation of nociceptors, specialized nerve endings in peripheral tissues such as skin, muscles, bones, or organs (Kendroud, 2022). There are two main types of nerve fibers that carry pain information: A $\delta$  and C fibers (Woolf & Ma, 2007). A $\delta$  fibers are finely myelinated and transmit rapid, localised pain, while C fibers are non-myelinated and transmit slow, dull, and diffuse pain (Kendroud, 2022; Klasser & Reyes, 2023).

Molecular, chemical, or physical mediators play an important role in increasing nerve sensitivity to pain. They bind to a specific receptor on the surface of neurons and trigger a cascade of signals within the cell. They can thus train the sensitivity of the nerve and modify the expression of genes (Woolf & Ma, 2007).

Inflammatory mediators such as bradykinin, prostaglandins, certain cytokines, histamine, and arachidonic acid are released when there is injury or inflammation. They make nerves more sensitive, even to mild stimulation (Grace et al. 2016). Nerve grow factor (NGF), a growth factor, can also act as an inflammatory mediator when present in excess, increasing pain sensitivity (Woolf & Ma, 2007).

Nerves themselves secrete neuropeptides such as substance P and CGRP (calcitonin gene-related peptide). These contribute to the intensification of pain signals and can trigger inflammation around the nerve (Besson & Chaouch, 1987). Serotonin and acetylcholine can also activate pain receptors (Kendroud, 2022).

Compounds such as potassium, ATP (adenosine triphosphate), lactic acid, and low-pH solutions are derived directly from metabolism or transformations in the cellular environment. These compounds can also stimulate nociceptors (Kendroud, 2022).

Byproducts of reactions in the body include reactive oxygen and nitrogen species (ROS/RNS). When present in large quantities, they disrupt nerve cells and intensify pain (Grace et al., 2016).

Physical stimuli include extreme temperatures, intense pressure, and tissue damage. They can also stimulate receptors and lead to inflammation (Kendroud, 2022).

Fibers use ion channels to sense pain information. There are TRP (Transient Receptor Potential) channels with receptor potentials such as TRPV1 (Transient Receptor Potential Vanilloid 1), TRPA1 (Transient Receptor Potential Ankyrin 1), and TRPM8 (Transient Receptor Potential cation channel, subfamily M, member 8); the sodium channel Nav1.7 encoded by the SCN9A (Sodium voltage-gated channels alpha subunit 9) gene; the mechanosensitive ion channel Piezo2. (piezo-type mechanosensitive ion channel component2) and the acid-sensitive ion channels (ASICs) (Mickle et al., 2016).

These channels and receptors then transform noxious thermal, mechanical, or chemical stimuli into electrical signals (Woolf & Ma, 2007).

Mutations in key genes can significantly impair nociceptive function and pain perception. Indeed, when mutations produce a loss of function in the SCN9A gene, there is then a congenital indifference to pain in the patient, without loss of nociceptive neurons. Furthermore, mutations in neurotrophic factors, such as nerve growth factor, can also negatively impair nociceptive function and pain perception (Woolf & Ma, 2007).

#### **1.4. Post-operative Pain**

Pain is generally classified according to its duration. Pain is defined as acute when that lasts less than three months, or chronic when it persists beyond that. Postoperative pain is one of the most common types of acute pain. Although generally temporary, its persistence beyond the normal healing phase can lead to chronic postoperative pain (Zghab et al., 2024).

In the field of oral and maxillofacial surgery, pain is considered orofacial pain. It refers to any pain experienced in the jaw, mouth, face, head, and neck (De Rossi, 2013). It may be due to nociceptive and/or inflammatory stimulation associated with dental, periodontal, or soft tissue procedures (Del Carmen Migueláñez Medrán et al., 2019).

The orofacial area is mainly innervated by branches of the trigeminal nerve (cranial nerve V) and is of great importance in the transmission of sensory information, particularly that of pain (Savoiaro & Strada, 1991). This nerve divides into three major branches. The ophthalmic nerve branch (V1) innervates the scalp, frontal area, upper eyelid, connective tissue, cornea, nose, nasal mucosa, frontal sinuses, as well as deep structures in this area, and part of the meninges. The maxillary nerve (V2) innervates the lower eyelid, cheek, nostrils, upper lip, maxillary teeth and gums, nasal mucosa, soft palate, uvula, maxillary, ethmoid, and sphenoid sinuses, and part of the meninges. Finally, the mandibular nerve (V3) is responsible for the innervation of the lower lip, mandibular teeth and gums, floor of the mouth, anterior two-thirds of the tongue, chin, jaw, external parts of the ear, part of the meninges and deep areas (Savoiaro & Strada, 1991).

Postoperative pain is often underestimated during follow-up. This fact leads to poor management of this pain (Bergeron et al., 2011). The management of pain usually involves several steps. There may be an assessment and preparation if surgery is planned, as well as a pain assessment, an analysis of the response to treatment postoperatively (Zghab et al., 2024).

#### **1.5. VAS Scale**

The visual analog scale (VAS) is a frequently used tool for its simplicity and precision. It quantifies pain levels and thus helps manage them (Besson, 1995).

The scale consists of a 10 cm horizontal line, without graduations. The left end reads "no pain" and the right end reads "maximum possible pain" (Figure 3). The patient must mark a cross on the line at the level of pain they feel. The pain will then be measured using a graduated scale. This provides a quantitative value of this pain (Delgado et al., 2018).

The VAS scale is particularly suitable for experienced adults who understand the concept of graduated intensity. It is used in various medical fields, such as dentistry (François et al., 2004). From a post-surgical perspective, it allows for monitoring the progression of pain and adapting pain treatment according to the patient's requirements (Delgado et al., 2018).

Furthermore, VAS can be problematic for children, elderly people with cognitive impairment, or patients with communication problems. In these cases, it would be better to use an alternative tool (Michel, 2009).

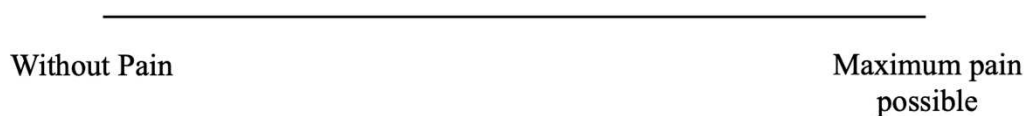


Figure 3 - Visual Analog Scale (VAS), adapted from Miguel, 2018

## **2. Periodontology**

### **2.1. Periodontal Disease**

Periodontology is a speciality of dentistry dedicated to the prevention, diagnosis, and management of diseases affecting the periodontal tissues (Kumar, 2024). These structures are crucial for the preservation of teeth in the arch. Their deterioration can lead to loosening or even tooth loss (Kumar, 2024; Kuraji et al., 2023).

The etiology of periodontal disease is multifactorial. It is based on the complex interaction between pathogenic microorganisms, the host organism's immune response, genetics, systemic factors, and environmental impacts (Kumar, 2024). Indeed, it is caused by a

microbial community, including bacteria, protozoa, archaea, and viruses (Deng et al., 2017).

The Inflammation-Mediated Polymicrobial-Emergence and Dysbiotic-Exacerbation (IMPEDE) model presents inflammation in five stages (0-4). It is integrated into the 2017 classification of periodontal disease. Stage 0 represents periodontal health. There is a normal presence of Gram-positive bacteria. The gums are healthy and free of inflammation. There is a balance of the oral microbiota (Van Dyke et al., 2020).

Dental plaque is the main cause of the disease. Indeed, this accumulation of biofilm brings together a complex community of bacteria, including some that are harmful to the periodontium. These bacteria interact with the immune system and cause an inflammatory response: gingivitis (Laforgia et al., 2024). This inflammation results in local collagen loss. This consequence is reversible if the inflammation resolves. The gingival environment begins to change. If the immune system is effective, it can still contain the infection. It represents the first stage (Van Dyke et al., 2020).

Furthermore, gingivitis can progress to periodontitis. The latter represents the irreversible destruction of the periodontal support tissues. The transition from gingivitis to periodontitis is called exacerbation. It is associated with dysbiosis, an imbalance of the periodontal microbiota: the second stage. The diversity, abundance, and proportions of subgingival microbiota species are altered due to persistent inflammation (Van Dyke et al., 2020).

During the third stage, inflammation and dysbiosis influence each other and increase. The immune system is no longer able to contain the infection. There is a predominance of pathogenic bacteria. The environment is favorable for anaerobic and inflammatory bacteria (Van Dyke et al., 2020).

Finally, during the fourth stage, inflammation and tissue damage are aggravated. There is a decrease in polymicrobial diversity due to infection (Deng et al., 2017; Van Dyke et al., 2020).

The plaque bacteria present at the initiation of periodontitis are predominantly commensal bacteria (Van Dyke et al., 2020). These are microorganisms that live in symbiosis with the host (Henderson & Wilson, 1998). Those located supragingival are Gram-positive,

such as *Streptococcus mutans*, *S. salivarius*, and *S. sanguis*. Subgingival bacteria are anaerobic due to the lack of oxygen in the gingival sulcus (Bellahsen, 2019).

Pathogens that are part of advanced periodontitis represent only a tiny fraction of the initial dental plaque. Excessive inflammation and the formation of periodontal pockets change the bacterial environment, making it anaerobic and promoting the proliferation of Gram-negative bacteria (Van Dyke et al., 2020).

It was once thought that bacteria could be classified into different categories. Indeed, Socransky's 1998 classification groups the bacteria responsible for periodontitis according to their association with the severity of periodontal disease (Figure 4) (Socransky et al., 1998; Hajishengallis & Lambris, 2012).

The "Red Complex" bacteria, *P. gingivalis*, *B. forsythus*, and *T. denticola*, were considered the main causes of periodontitis, being associated with advanced periodontal lesions, bone destruction, and chronic inflammation. The "Orange Complex" bacteria were associated with the development of periodontal pockets. They appear before the Red Complex bacteria and prepare their colonisation. The "Green Complex" was considered weakly pathogenic. These bacteria were, according to Socransky, weakly associated with periodontitis and present mainly in healthy sites. However, they could contribute to inflammation if the biofilm evolved. The "Yellow Complex" was associated with a healthy periodontium. These bacteria are among the first to colonise the tooth surface (Socransky et al., 1998).

Nowadays, it is established that inflammation and dysbiosis are the primary etiologies of the disease, not the presence of specific bacteria. However, *P. gingivalis* is suspected of playing a key role in the progression of the disease. Indeed, its ability to cause tissue destruction and alter the immune response could have an impact on the development of the entire biofilm and thus lead to inflammation that can destroy tissue (Hajishengallis & Lambris, 2012). Thus, the treatment of periodontitis should not only target bacteria, but also inflammation (Kuraji et al., 2023).

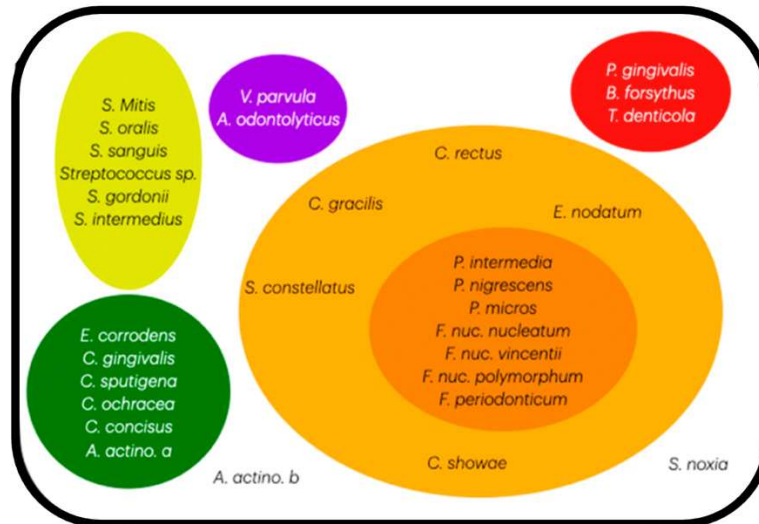


Figure 4 - Diagrammatic representation of Socransky's complexes, adapted from Fernandes, 2024

## 2.2. Tissue Damage

Tissue damage in periodontal disease begins with an initial lesion. This is the body's first reaction to the presence of bacterial biofilm on the tooth surface. Signs invisible to the naked eye then begin. There are changes at the vascular level. The activation of endothelial cells, the widening of intercellular spaces, and local vascular dilation lead to increased capillary permeability. Gingival fluid, intended to eliminate harmful substances produced by bacteria, is then able to pass through the vessel membranes. Neutrophils are the first cells of the immune system to arrive in the gingival sulcus to defend the tissues. This is the innate immune response (Hassan, 2022).

During early damage, the bacterial biofilm thickens and spreads infragingivally. Epithelial tissue begins to multiply in an attempt to create a stronger barrier against microbes. In addition, collagen fibers become disrupted to promote greater infiltration of immune cells such as polymorphonuclear neutrophils (PMNs), macrophages, lymphocytes, plasma cells, and mast cells (Kinane & Lappin, 2001). Macrophages play a central role in phagocytosing bacteria, attracting other immune cells, and triggering inflammation. Fibroblasts, normally responsible for maintaining tissues, undergo a process of apoptosis. At the molecular level, inflammatory agents proliferate. They accentuate the inflammatory response and recruit new immune cells. Clinically, gingivitis

manifests as swelling, hemorrhage upon probing, and sulcus dilation that evolves into a fictitious pocket without loss of attachment (Hassan, 2022).

The next stage is the established lesion. The inflammation transforms into a chronic condition (Kurgan & Kantarci, 2017). Other defence cells, plasma cells, T and B lymphocytes, become predominant. The epithelium continues to sink into the connective tissue, and the epithelial bond becomes increasingly permeable (Kinane & Lappin, 2001; Kurgan & Kantarci, 2017). Collagen fibers degrade further, but there is no damage to the bones or ligaments. These clinical signs are those of moderate to severe gingivitis. It is still reversible if the biofilm is eliminated (Hassan, 2022). Eventually, the lesion progresses to an advanced one, periodontitis. The damage is then irreversible (Hassan, 2022). Inflammation descends deep into the tissues, where plasma cells are largely dominant. The junctional epithelium moves towards the apex, forming a true periodontal pocket (Kinane & Lappin, 2001). Matrix metalloproteinases (MMPs) participate in the degradation of connective tissue and alveolar bone. Regulatory mechanisms are triggered and there are secretions of IL-10, IL-4, IL-13, and MMP inhibitors. Fibroblasts and osteoclasts are also stimulated to promote tissue repair. However, periodontitis continues to evolve in a precarious balance between tissue deterioration and healing attempts (Hassan, 2022).

### **2.3. Interactions with the host**

#### Bacterial virulence factors

Bacteria deploy various mechanisms to evade host immune defences and cause chronic inflammation. Lipopolysaccharides are molecules found on the surface of Gram-negative bacteria, such as *P. gingivalis*. When these bacteria degrade, LPS is released into the tissues. Immune cells, such as macrophages, detect this LPS using specific receptors, TLR4. They recognise the danger and release messenger molecules, pro-inflammatory cytokines, such as interleukin-1 (IL-1) and tumour necrosis factor alpha (TNF- $\alpha$ ). These contribute to increased inflammation (Vesna, 2018).

Furthermore, the bacterium *Porphyromonas gingivalis* produces proteolytic enzymes, such as gingipains. These enzymes are used to break down and degrade proteins in the

human body, such as collagen or immunoglobulins. They destroy the body's natural barriers. This bacterium also produces an adhesion molecule, hemagglutinins. These help the bacterium attach to human cells and other bacteria, facilitating its movement into tissues. Thus, these two molecules degrade host proteins and facilitate the invasion of periodontal tissues by *P. Gingivalis* (Śmiga et al., 2020).

#### Immune escape strategies

Pathogenic bacteria also develop strategies to manipulate the immune response. Some bacteria alter their surface through glycosylation. Macrophage cytokines then no longer recognise these bacteria. Macrophage activity is impaired. The bacteria are no longer eliminated by the immune system (Amano et al., 2014).

Furthermore, species such as those in the "Red Complex" can pass themselves off as a host cell. Sialic acid is a sugar normally present on the surface of the body's cells. It plays an important role in cell-to-cell recognition and communication. The bacteria use their enzyme neuramidase to capture this acid, feed on it, and decorate their surface with it. This allows them to pass themselves off as a host cell and evade immune recognition (Amano et al., 2014).

#### Bone destruction and tissue degradation

The progression of periodontal disease involves bone destruction processes. These contribute to postoperative pain when surgery is performed on these already damaged tissues (Correa & Rengifo, 2013).

Osteoclasts are specialised cells whose primary function is bone resorption. The RANKL (Receptor Activator of Nuclear factor Kappa-B Ligand) molecule stimulates osteoclasts by binding to receptors called RANK (Receptor Activator of Nuclear factor Kappa-B). Furthermore, osteoprotegerin (OPG) is a protein that acts in the regulation of bone destruction. It binds to RANKL and prevents it from binding to RANK. It therefore blocks osteoclast activation. Certain bacteria stimulate the RANKL/RANK pathway by increasing RANKL production and decreasing OPG production. They thus modify the bone regulatory system, promoting its resorption (Correa & Rengifo, 2013). Matrix metalloproteinases (MMPs) are natural enzymes produced by the body's cells. Their role is to break down matrix proteins, such as collagen, to renew or repair tissue. During

periodontal inflammation, inflammatory cytokines are released. These activate MMPs. Thus, MMPs become more active than usual. They will then excessively degrade collagen, an essential protein in the support structure of the gums and connective tissue. The supporting tissue will loosen. This will lead to the formation of periodontal pockets (Vasna, 2018).

## **2.4.Periodontal Treatment**

Treatment of periodontitis aims to eliminate bacterial infection, halt disease progression, restore supporting structures, and prevent recurrence (Hbibbi et al., 2014). This therapeutic approach is divided into two broad categories: nonsurgical treatment and surgical treatment (Laforgia et al., 2024).

### Non-Surgical Treatment

Standard protocol indicates that nonsurgical treatment is the first step. It primarily involves scaling and root planning. These procedures aim to manually remove tartar and plaque from the supra and infra-gingival areas. It is also essential to provide the patient with thorough oral hygiene education to ensure long-term management (Laforgia et al., 2024).

When the response to nonsurgical treatment is insufficient, surgery may be considered (Heitz-Mayfield & Lang, 2013).

### Surgical treatment

Surgical intervention is recommended if deep periodontal pockets remain after non-surgical treatment, or when significant bone defects are identified (Lang & Bartold, 2018).

It facilitates access to tooth roots and deeper structures, promotes complete cleanliness, tissue resection or regeneration, and in some situations, improves the appearance of the gums (“Comprehensive Periodontal,” 2011).

### Access surgery

Access surgery aims to provide direct visual and mechanical access to facilitate the removal of tartar and bacterial biofilm from dental roots. It is based on the elevation of a mucoperiosteal flap to expose root surfaces and bone defects. The modified Widman flap technique is often used: it allows dissection with optimal tissue rehabilitation. After cleaning, the flap is repositioned and sutured. This procedure reduces periodontal pockets, but without explicitly targeting tissue regeneration. The alveolar bone is not modified, and the soft tissues are little or not cut. (Sanz-Sánchez et al., 2020).

### Resective surgery

Resective surgery aims to reduce or eliminate periodontal pockets. It restores a favorable gingival shape and bone morphology. Ideally, a wave-shaped bone architecture would be achieved that matches the normal shape of the gingival margin. This type of surgery facilitates oral hygiene and periodontitis treatments by having a smooth and regular bone contour (Gupta et al., 2021). It includes several techniques. Soft tissue procedures include gingivectomy and gingivoplasty. Bone interventions include osteotomy and osteoplasty (“Comprehensive Periodontal”, 2011).

This surgery is indicated when the periodontal pocket is shallow and the support is not lost, or if there is no adjacent tooth. In addition, an osteotomy can be performed on the buccal bone in the mandibular molar region if an infrabony pocket is present in the interradicular area. Furthermore, resective surgery is contraindicated if the bone support of the tooth is already weak or if the surgery results in gingival formation that would make it difficult to maintain cleanliness (Gupta et al., 2021).

### Regenerative surgery

Periodontal regeneration involves restoring the original structure and function of lost tissues. The goals of this surgery are to increase periodontal attachment and bone tissue, as well as to reduce the depth of periodontal pockets. It is indicated when a tooth's periodontal pocket is too deep or periodontal support is too weak to be treated with resective surgery. Furthermore, it also helps restore tooth function by reducing tooth mobility. Its third goal is to achieve successful treatment with minimal or no gingival recession (Cortellini & Tonetti, 2015).

The first step of surgery is mechanical treatment, which may be followed by chemical treatment of the root surface. This regeneration is defined by the creation of new cement associated with collagen fibers, the establishment of a periodontal ligament, and the formation of new alveolar bone (Terdjman, 2019).

### Guided Tissue Regeneration (GTR)

GTR is a regenerative surgery method. It involves the application of a resorbable or non-resorbable membrane to damaged periodontal areas. This membrane will act as a barrier and promote targeted recolonization of the dental surface. Indeed, it will prevent gingival cells from filling the space and thus promote selective recolonization of isolated spaces by desmodontal cells, cells of the periodontal ligament. This will promote the regeneration of the attachment system (Terdjman, 2019).

### Enamel matrix-derived proteins (EMDPs)

EMDPs, such as purified porcine amelogenins (Emdogain®), are used to stimulate periodontal regeneration. They are produced from porcine tooth buds (Terdjman, 2019).

They are applied to the root, where they form a bioactive gel that mimics the extracellular matrix of the developing tooth. Thus, they replicate the processes that occur during embryonic and root development and promote the formation of new periodontal attachment. This results in the formation of neocementum, the appearance of bone islands, and the arrangement of periodontal ligament fibers (Terdjman, 2019). This technique can be used alone or in combination with other regenerative techniques, such as bone grafts (Cortellini & Tonetti, 2015).

### Plastic surgery

Periodontal plastic surgery encompasses all methods of covering gingival recessions (Antoun, 2024). These recessions were described in 1985 by Miller, who classified them into four groups, based both on the level of the marginal gingiva in relation to the mucogingival line and on the level of the underlying alveolar bone (Figure 5) (Terdjman, 2019).

Class 1 represents marginal tissue recession that does not affect the mucogingival line, with no loss of bone or soft tissue in the interproximal area. The prognosis of surgery is complete root recovery.

In Class 2, marginal tissue recession reaches or extends beyond the mucogingival line, with no loss of bone or soft tissue in the interproximal region. The prognosis for surgery is also complete root recovery.

Class 3 refers to marginal tissue recession reaching or extending beyond the mucogingival line, resulting in bone and soft tissue loss in the interproximal area. This may also be due to dental malposition preventing complete root coverage. The prognosis for surgery is partial root coverage.

Class 4 represents marginal tissue recession reaching or extending beyond the mucogingival line. There is then significant bone and/or tissue degradation in the interproximal region. There may also be significant dental positional abnormality. The prognosis for surgery does not predict root coverage.

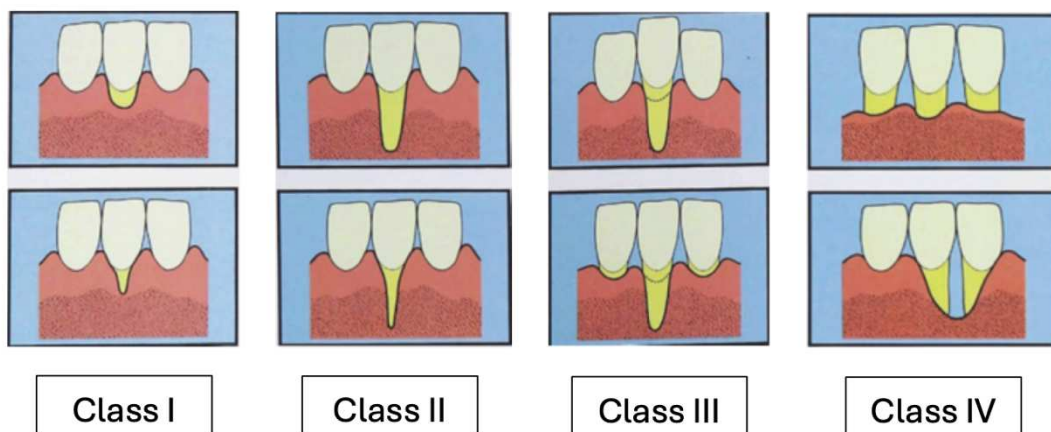


Figure 5 - Miller's Classifications of recessions, adapted from Antoun, 2024

The goal of plastic surgery is to permanently and to stabilise the reposition the soft tissues at the cemento enamel junction (CEJ) after healing from the surgery (Terdjman, 2019). This will ensure functional and aesthetic success for the patient (Antoun, 2024).

As with regenerative surgery, the first step in plastic surgery is mechanical and sometimes chemical treatment of the root surface (Terdjman, 2019).

This type of surgery involves grafting tissue from the palate, tuberosity, or edentulous ridge to cover the gingival recession. In the palate, the harvest area can range from the distal surface of the maxillary central incisor to the distal surface of the first molar. However, the ideal location is the maxillary premolar region, where it is possible to obtain a graft of appropriate height and thickness (Terdjman, 2019).

### Free Gingival Graft

Free gingival graft (FGG) is a type of plastic surgery. It involves the extraction of a segment of epithelial-connective tissue from the donor site to cover a recipient area (Antoun, 2024). The graft is composed of a layer of epithelium on the surface and a layer of connective tissue deeper down. In addition, the technique of de-epithelialization of the epithelial-connective tissue graft allows for the creation of a connective tissue graft (Terdjman, 2019).

The recipient site is prepared with several horizontal and vertical cuts. The graft must have a minimum thickness of 1 mm. When there is no loss of interproximal attachment it covers the junction between the enamel and cement and is held in place with intermittent sutures at the papillae and lateral edges. It is not sutured apically. (Antoun, 2024).

### Connective Tissue Graft

Submerged connective tissue grafting (CTG) is another type of plastic surgery. The graft, a purely connective tissue, is removed from the donor site, leaving the epithelial tissue attached to the rest of the mucosa. This allows the donor site to be fully closed. This graft is then used to cover the root surface (Terdjman, 2019).

### *Laterally positioned flap*

Laterally displaced flap is a plastic surgery technique. It is characterized by the use of tissues mesial or distal to the gingival recession in order to cover it. The flap is displaced both lateral and coronal. This technique can be performed with or without the addition of a connective tissue graft. This method is recommended only if there is an adequate gingival band surrounding the recession (Terdjman, 2019).

### *Coronally positioned flap (CAF)*

CAF is one of the preferred methods for restoring gingival recessions. The apical tissues of the exposed root are used to cover it. The flap can be used with or without discharge. This technique is frequently used with a connective tissue graft (Terdjman, 2019).

### *Tunneling*

The tunnel method protects the gingival papillae. Tunnel formation is achieved by cutting the sulcus and detaching it from the gingiva toward the apex and laterally. The gingival attachment at the papillae is maintained, thus preserving aesthetics. The connective tissue graft is placed in the tunnel and secured with mattress stitches and hanging stitches (Antoun, 2024).

## **3. Factors Influencing Pain Perception**

### **3.1. Sex**

Sex influences pain perception and intensity (Eltumi & Tashani, 2017). Several studies have shown that women generally tend to experience greater pain and sensitivity compared to men, in various clinical and experimental settings (Fillingim et al., 2009). They are more sensitive to different types of painful stimuli, such as pressure, heat, cold, and electric shock (Eltumi & Tashani, 2017). This discrepancy could be explained by biological, hormonal, psychological, and sociological factors (Mogil, 2012).

From a biological perspective, sex hormones are crucially important. For example, oestrogen can influence pain transmission. Thus, pain sensitivity varies during the menstrual cycle (Eltumi & Tashani, 2017). Furthermore, research indicates that women and men have different pain inhibition mechanisms. They do not activate the same brain circuits to reduce pain (Mogil 2012).

Furthermore, psychosocial factors such as cultural expectations, gender roles, and methods of pain expression may also explain this difference. Indeed, women may be more comfortable verbalizing their pain, while men may minimize or hide it for cultural reasons (Eltumi & Tashani, 2017; Mogil, 2012).

Regarding postoperative pain, some studies have indicated that women report more severe pain in the days following surgery, although these differences are not always statistically significant (Fillingim et al., 2009).

### **3.2. Age**

Age plays a role in how we perceive, experience, and modulate pain. Throughout life, pain sensitivity undergoes changes based on nervous system maturation and the accumulation of painful experiences and illnesses (Gidson & Farrell, 2004).

In young and middle-aged adults, pain sensitivity tends to be stable. However, it can fluctuate depending on psychological and social contexts, as well as overall health. The interpretation and tolerance of new painful episodes can also be influenced by previous pain experience (Eltumi & Tashani, 2017).

Older adults have higher pain thresholds, greater temporal summation, and less effective pain attenuation compared to middle-aged individuals (Riley et al., 2013). Indeed, there are changes in the central and peripheral nervous systems. These affect areas of the brain involved in nociceptive processing, such as the cortex, hippocampus, insula and thalamus. There is loss of neurons and dendrites, and neurofibrillary abnormalities. In addition, the synthesis, axonal transport, uptake, and receptor binding of neurotransmitter systems are also altered (Gibson & Farrell, 2004).

### **3.3. Smoking Habits**

The influence of smoking on pain occurs through several mechanisms (Shi et al., 2010). It plays a significant role in pain regulation, especially in the post-surgical setting. According to several studies, patients who smoke tend to report more severe post-operative pain and to require more painkillers compared to non-smokers (Chiang et al., 2016).

From a pathophysiological perspective, nicotine and other compounds present in cigarette smoke exert a complex influence on the nervous system. In the short term, nicotine can act as a mild pain reliever by activating nicotine receptors and boosting dopamine secretion. However, in the long term, smoking is linked to sensitisation of the nociceptive system and a reduction in the endogenous ability to control pain. This can lead to more

intense pain following surgery (Shi et al., 2010). Decreased oxygen delivery to tissues is a central issue in oral and maxillofacial surgery, where adequate blood flow is essential for tissue repair (Parker et al., 2019).

Tobacco also impacts tissue healing mechanisms. It activates the sympathetic nervous system, which increases vasoconstriction and decreases blood flow to tissues. Additionally, carboxyhemoglobin, a form of carbon monoxide, is found in cigarette smoke. It binds to hemoglobin and prevents oxygen from being transported efficiently. This decreases the oxygen supply to tissues, delaying wound healing. This can prolong the suffering of patients after surgery (Shi et al., 2010).

### **3.4. Diseases**

#### Diabetes

Diabetes melitus is recognized to significantly influence pain perception after surgery. This change in perception is primarily attributable to neurological complications related to diabetes, particularly diabetic neuropathy. This disease alters nociceptive transmission pathways (Schreiber, 2015). Patients frequently develop allodynia, painful sensations to weak stimuli, and hyperalgesia, an amplified sensitivity to painful stimuli. Conversely, for some patients, neuropathy reduces the perception of painful stimuli, which can mask significant postoperative pain (Coulibaly, 2024).

Furthermore, diabetes is linked to chronic low-grade inflammation and amplified oxidative stress, both of which can increase pain responses, even in the absence of obvious nerve damage (Callaghan et al., 2012).

Furthermore, perioperative hyperglycemia can impair wound healing and aggravate inflammatory responses, leading to increased postoperative pain (Duggan et al., 2017).

#### Immuno-inflammatory pathologies

Immunosuppression can be due to pathological causes, such as HIV, cancer, and autoimmune diseases, or to iatrogenic causes, such as chemotherapy, corticosteroids, and immunosuppressants. This immunosuppression can alter the perception and development of pain after surgery. For these patients, the weakened immune system leads to changes

in the inflammatory response that can alter pain perception and prolong pain episodes due to delayed healing or infectious complications (Page, 2005).

Pain is strongly associated with inflammation, involving mediators such as pro-inflammatory cytokines, such as IL-1 $\beta$ , IL-6, and TNF- $\alpha$ . However, the immune system also secretes analgesic mediators, such as opioid peptides, capable of attenuating pain in inflamed tissues. General pain is determined by the balance between hyperalgesic and analgesic mediators. However, immunosuppressive treatments can alter this balance, altering the processes of pain induction and attenuation (Rittner et al., 2002).

Furthermore, research has indicated that patients diagnosed with HIV may experience increased sensitivity to neuropathic pain. Indeed, prolonged use of antiretroviral therapy causes neurotoxicity and immune system disruption (Bloe et al., 2022).

### Obesity

Obesity is recognized as a risk factor that can contribute to increased and prolonged pain after surgery (Majchrzak et al., 2019).

This altered pain sensation in obese patients may be explained by various pathophysiological processes (Galassi, 2025).

On the one hand, obesity is linked to a chronic low-grade pro-inflammatory condition, signalled by a permanent increase in inflammatory cytokines such as TNF- $\alpha$ , IL-6, and C-reactive protein (CRP). This systemic inflammatory response can make nociceptors more sensitive, which could intensify the pain response after surgery (Galassi, 2025).

Furthermore, individuals suffering from obesity often have mechanical problems, such as joint overload or pressure on nerves. They also experience metabolic changes, such as insulin resistance and fatty tissue dysfunction. All of these disturbances can alter the pain process (Galassi, 2025).

### Depression

Depression is an important psychological factor that can intensify pain perception after surgery (Edwards et al., 2009). Individuals with depression show increased central

sensitivity, a lowered pain threshold, and a reduced effectiveness of internal pain regulation systems (Klaunberg et al., 2008).

This phenomenon is partly explained by altered responses to noxious stimuli. These defects are located in brain networks associated with pain and mood, such as the prefrontal areas, the subgenual anterior cingulate cortex, and limbic structures (Berna et al., 2010). Additionally, these patients with depression and higher pain levels consume more analgesics and are at higher risk of chronic pain after surgery (Edwards et al., 2009).

### **3.5. Type of Procedure**

Various technical factors influence the perception of pain following periodontal surgery, such as the type of procedure performed (Mei et al., 2016), the extent of the surgical site, and the time required to complete the operation. These factors directly influence the extent of tissue trauma, and therefore the inflammatory response and pain experienced after surgery (Penarrocha et al., 2006).

The intensity and duration of postoperative pain are greatly influenced by the type of periodontal surgery. More invasive surgical procedures, such as plastic surgery, are associated with more significant postoperative pain (Mei et al., 2016). Indeed, gum grafting causes significant pain at the donor site on the palate, as well as at the recipient site (Almeida et al., 2023). Furthermore, regenerative surgeries are also associated with intense postoperative pain. The use of membranes and bone substitutes prolongs surgery time and intensifies local inflammation (Simonelli et al., 2023). Moreover, surgical procedures such as osteotomy or root sectioning are also linked to increased pain (Lago-Méndez et al., 2007).

Furthermore, less invasive surgical methods, such as single-flap elevation, generally result in reduced pain and faster functional recovery (Simonelli et al., 2023).

The size of the surgical site is also a crucial factor. Indeed, an operation involving a large number of teeth or a large area result in more extensive trauma, more generalised inflammation, and therefore often greater pain (Lago-Méndez et al., 2007).

Finally, the duration of the surgical procedure is also considered to aggravate pain. A prolonged surgical procedure is generally associated with excessive tissue manipulation

and dehydration. Constant nerve stimulation and increased physical stress on the patient are other outcomes of a long surgery. All of these factors can intensify the sensation of postsurgical pain (Masset & Henry, 2019).

### **3.6. Medications**

#### Antibiotics

The use of systemic antibiotics to prevent wound infection following periodontal surgery is debatable for patients without a unique medical history. Some authors believed that systemic antibiotics could improve wound healing and lessen pain and oedema (Lui et al., 2017). Despite this, the ability of an antimicrobial drug to effectively reduce pain occurring during these inflammatory conditions is unclear. It is said that by minimizing the bacterial load, antibiotics reduce the inflammatory reaction and thus reduce the sensation of pain (Fouard, 2002).

Other authors, however, suggested that systemic antibiotics might not be able to enhance wound healing, lower the rate of infection, or lessen pain, inflammation, or oedema following surgery (Fouard, 2002; Lui et al., 2017).

During regenerative surgeries, materials like bone grafts and enamel matrix proteins (EMD) are sometimes used. Those could affect the choice of the surgeons to provide systemic antibiotics during the post-operative phase. However, there is no clear indication in the literature for the use of antibiotics to control infection after periodontal surgeries (Liu et al., 2017).

#### NSAIDs

Nonsteroidal anti-inflammatory drugs (NSAIDs) are among the most prescribed treatments for pain management after periodontal surgery (Caporossi et al., 2020). Their primary mechanism of action is to reduce the production of prostanoids, which play a crucial role in nociceptor sensitisation and the onset of inflammation. To this end, NSAIDs inhibit the activity of both isoforms of the cyclooxygenase enzyme (COX-1 and COX-2). The COX-2 isoform is primarily expressed during an inflammatory process, and the COX-1 isoform is involved in the regulation of physiological functions. COX-1 inhibition causes adverse effects such as gastric mucosal irritation and toxic effects on the

kidneys. Most NSAIDs are inhibitors of both isoforms, and only molecules such as celecoxib are truly selective for COX-2 (Devillier, 2001).

By blocking the formation of this prostaglandin, NSAIDs have a dual effect: analgesic by directly reducing the sensation of pain, and anti-inflammatory (Devillier, 2001).

### Analgesic

The use of common pain medications such as paracetamol (also called acetaminophen) appears effective in how postoperative pain is perceived and progresses (Toms et al., 2008).

This treatment primarily exerts its effect by inhibiting cyclooxygenase (COX-3) centrally and reducing the synthesis of prostaglandins, which are responsible for transmitting pain signals. It can thus contribute to better management of postoperative pain when used alone or in combination with other analgesic agents (Toms et al., 2008).

Paracetamol is often used in oral and periodontal surgery to manage mild to moderate pain, thanks to its good gastric tolerance, the absence of influence on platelet aggregation, and its superior safety profile compared to non-steroidal anti-inflammatory drugs (McNicol et al., 2016).

When administered immediately after surgery, it maximises its analgesic effect, helping to lower the pain threshold observed in the 24 to 48 hours postoperatively (McDaid et al., 2010).

Numerous studies have shown that the combination of paracetamol and an NSAID generates a synergistic effect for improved analgesia: paracetamol acts primarily centrally by inhibiting COX-3, while ibuprofen acts peripherally by inhibiting COX-1 and COX-2. This multimodal approach often provides superior analgesia than that obtained with each drug alone, while allowing for a reduction in individual doses and therefore fewer side effects (McDaid et al., 2010).

Regarding periodontal procedures, its use at 1000 mg during the first few hours after surgery helps control the pain experienced, thereby promoting better patient well-being and recovery (Seymour, 1983).



### **III. MATERIALS AND METHODS**

The aim of this thesis is to evaluate pain, using a visual analogue scale (VAS), and identify the factors that influence postoperative pain in different surgical periodontal treatments.

#### **1. Characterisation and relevance of the study**

This investigation was an observational and longitudinal study.

Data were collected by completing two questionnaires. The first, composed of two parts, was completed by the researcher. The first part was completed on the day of the procedure to collect data on medical history and the surgical intervention, and the second part on the day of suture removal, concerning adherence to postoperative care instructions. The second questionnaire was given to the patient on the day of surgery, along with eight visual analog scales (VAS). The patient was asked to complete these scales three times a day (morning, afternoon, and evening) for the three days following the operation and on the day of suture removal. This questionnaire was to be returned to the researcher on that same day. All VAS measurements were performed by the researcher using the same ruler.

Periodontal surgeries are often followed by postoperative pain, so it is important to study the variables that can influence it. By identifying them, the clinician can better control these factors, minimizing postoperative complications. Thus, by increasing predictability and adherence to surgical periodontal treatment, the success rate of periodontal treatment will increase.

#### **2. Objectives of the Study**

The objectives of this study were to assess pain level, using a VAS scale, after surgical periodontal treatment and identify the factors that influence it in the postoperative period.

Null Hypothesis (H0): The degree of postoperative pain is not dependent on factors such as age, sex, smoking habits, diseases, such as diabetes, immunodeficiency, obesity, depression, periodontal disease, type of periodontal surgery (resective, regenerative and plastic), technique performed, teeth involved, duration of surgery, prescribed medications and compliance with post-operative care.

Alternative Hypothesis (H1): The degree of postoperative pain depends on factors such as age, sex, smoking habits, diseases, such as diabetes, immunodeficiency, obesity, depression, periodontal disease, type of periodontal surgery (resective, regenerative and plastic), technique performed, teeth involved, duration of surgery, prescribed medications and compliance with post-operative care.

### **3. Sample**

The population selected for this study included patients who underwent periodontal surgeries in Postgraduate program in Periodontology, Postgraduate specialization course in Periodontology, and in Assistance consultation in Periodontology, between February 2025 and June 2025 at the Egas Moniz School of Health and Science.

A sample of 80 patients (N=80), including both males and females, was obtained who met the established inclusion and exclusion criteria.

12 other patients were seen and given the questionnaires, but were excluded from the analysis due to failing to see them on the suture removal day. The questionnaires with the pain levels were not given back.

#### **3.1. Inclusion Criteria:**

- patients undergoing periodontal surgery (access, resective, regenerative, or periodontal plastic surgery) in the Periodontology Department of the Egas Moniz Dental Clinic,
- patients who agree to participate in the study and who sign the informed consent form,
- patients who can read Portuguese,
- patients over 18 years of age

#### **3.2. Exclusion Criteria:**

- pregnant and lactating women,
- person with intellectual disability

#### **4. Clinical Procedure**

Patients selected for periodontal surgery did not have any systemic condition that contraindicated this type of procedure. This assessment was carried out by the periodontology department team. Only patients with a plaque index (PI) and gingival index (GI) less than 15% were admitted. All surgeries were performed in an aseptic environment, using local anaesthesia and following an appropriate surgical procedure.

Resective surgeries were performed to remove soft and/or hard tissue (bone/tooth), with the aim of eliminating or reducing periodontal pockets in cases of periodontitis.

In one case of regenerative surgeries, a resorbable collagen membrane (Bio-Gide) and synthetic bone (Bio-Oss) were used for bone defects. Periodontal plastic surgeries were performed to augment the keratinised gingiva or to cover the roots. During these surgeries, palate, free gingival, or connective tissue grafts were performed.

For postoperative precautions, most patients were prescribed chlorohexidine gel (0.2%) and rinse (0.12%) for 2 weeks, twice daily. In addition, patients received clear instructions to follow: discontinue mechanical control in the intervention area for 2 weeks; eat soft and cold foods in the days following surgery; begin using gel and rinse, if prescribed, only 48 hours after the procedure; and abstain from physical exercise for 1 week. In most surgeries, an antibiotic (amoxicillin 1g, 12/12h – 8 days), a nonsteroidal anti-inflammatory drug (ibuprofen 600mg, 12/12h – 3/4 days) and an analgesic (paracetamol 1000mg, SOS) were prescribed.

Suture removal was performed over a period of 7 to 14 days during a periodontology consultation in Postgraduate program in Periodontology, in Postgraduate specialization course in Periodontology or in Assistance consultation in Periodontology.

#### **5. Ethical Consideration**

This study was approved by the Ethics Committee of the Egas Moniz School of Health and Science on the 5<sup>th</sup> of February 2025. The process number is 1558. The approval documents are included in the appendix.

The study was conducted in accordance with the ethical guidelines of the updated Declaration of Helsinki, and published in JAMA Network on October 19, 2024. Strict measures were taken to ensure general patient data protection regulations..

## **6. Material**

For this study, the following were required:

- Questionnaire 1 (with two sections)
- Questionnaire 2
- Ruler for measuring the VAS scale

## **7. Data Collection**

Data were collected through the completion of two questionnaires. The first one consists of two parts and was administered by the researcher. The first part was administered on the day of surgery to collect clinical history and surgical-related data, and the second part was administered on the day of suture removal to assess postoperative care. The second questionnaire, which included VAS scales, was given on the day of surgery. The patient was asked to complete the form within three days of surgery and on the day of suture removal, returning it that day.

All VAS were measured by the student using the same ruler.

The questionnaire template is available in the appendices.

## **8. Statistical Analysis**

Statistical analysis was performed using IBM SPSS Statistics version 30.0 software. The data obtained were first subjected to descriptive statistical analysis. For the quantitative variables, measures of central tendency (average, median) and dispersion (standard deviation, variance, minimum, maximum, range, interquartile range) were calculated. A 95% confidence interval was also determined for the average.

For qualitative variables, frequency analyses were performed to obtain counts, absolute percentages, valid percentages, and cumulative percentages.

#### IV. RESULTS

This section presents the results obtained in this study, including descriptive statistics (sample characterisation) and inferential statistics (relationship between pain and other variables).

##### 1. Descriptive Statistics – Sample Characterisation

The periodontal surgeries were performed by students and dentists at the Dental Clinic of Egas Moniz School of Health and Science. Of the 80 patients, 45 were female and 35 were male. 21.5% of the patients were smokers. The details of the sample's characteristics are shown in Table 1.

Age (media)	52,31
Sex (in %)	N=80
Female	45 (56,3)
Male	35 (43,8)
Smoking habits (in %)	N=80
No	63 (78,8)
Yes	17 (21,3)
Average number of cigarettes per day	N=80
0	63 (78,8)
<10	9 (11,3)
>10	8 (10,0)
Diabetes (in %)	N=80
No	76 (95)
Yes	4 (5)

Diseases with influence on the immune-inflammatory response (in %)	N=80
No	74 (92,5)
Yes	6 (7,5)
Obesity (in %)	N=80
No	78 (97,5)
Yes	2 (2,5)
Depression (in %)	N=80
No	74 (92,5)
Yes	6 (7,5)

*Table 1 - Descriptive analysis of demographic and medical data of patients included in the study.*

The patients' ages ranged from 18 to 82 years. The distribution of patients by different age groups is shown in Chart 1. The distribution of patients into male and female groups can be seen in Chart 2.

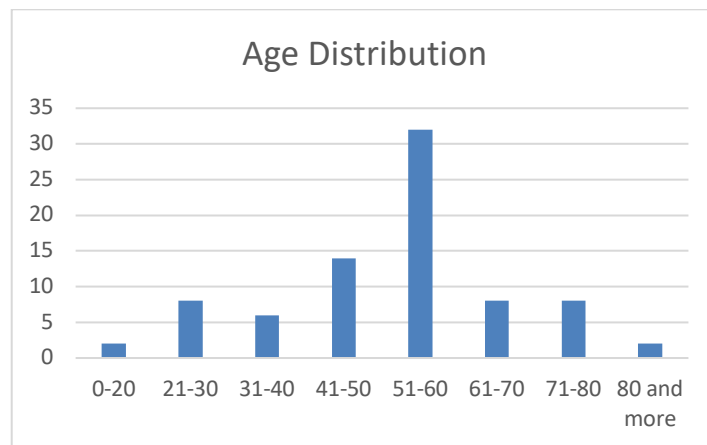


Chart 1 - Age Distribution by Age Groups

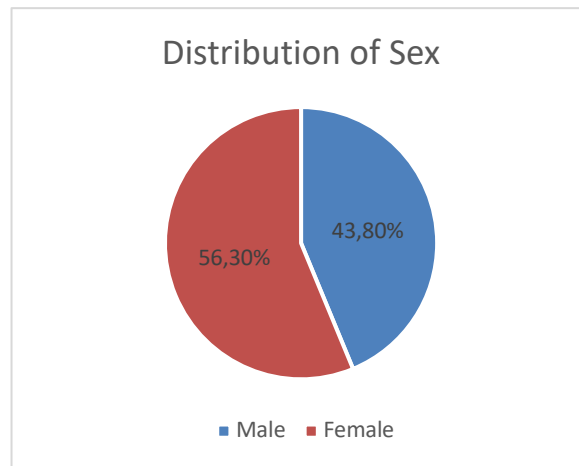


Chart 2 - Percentages of Sex in the study

Most patients presented periodontitis (61.3%). Most patients had stage III periodontitis (41.3%), and the majority of patients had stage B periodontitis (32.5%). Distribution of patients according to the latest classification of periodontal and peri-implant conditions and diseases (Papanou et al. 2018) can be seen in Table 2, Chart 3 and Chart 4.

Gingivitis (in %)	N=80
No	80 (100)
Yes	0 (0)
Periodontitis (in %)	N=80
No	31 (38,8)
Yes	49 (61,3)
Periodontitis stage (in %)	N=80
I	3 (3,8)
II	7 (8,8)
III	33 (41,3)
IV	6 (7,5)

*Evaluation of Post-Operative Pain in Patients Submitted to Periodontal Surgical Treatments Using the Visual Analogue Scale*

Periodontitis grade (in %)	N=80
A	8 (10)
B	26 (32,5)
C	15 (18,8)

Table 2 - Descriptive analysis of Gingivitis, Periodontitis, Periodontitis stage and grade

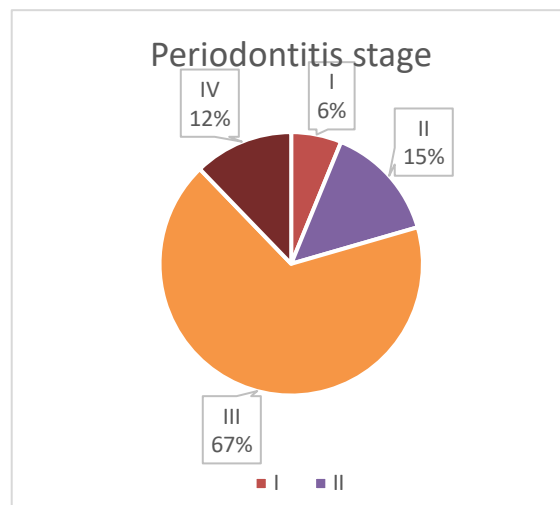


Chart 3 - Percentages of Periodontitis stage

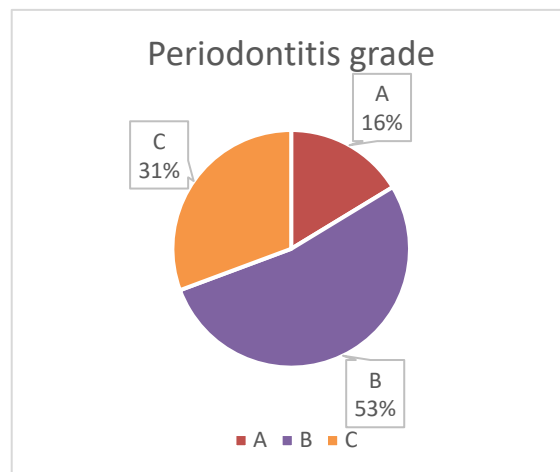


Chart 4 - Percentages of Periodontitis grade

Table 3 and Chart 5 show the various surgical procedures that were performed throughout the study. 57.5% of surgical procedures were plastic periodontal surgeries. Only 5% of procedures were regenerative. 55% of procedures were performed on the maxilla, compared to 45% on the mandible. The average procedure duration was 120 minutes.

Type of surgery (in %)	N=80
Resective	28 (35)
Regenerative	4 (5)
Plastic	48 (60)
Specification of the type of surgery (in %)	N=80
Resective	28 (35)
Regenerative with EMD	1 (1,3)
Regenerative with EMD + Bone substitute	0 (0)
Regenerative GTR	0 (0)
Regenerative GTR + Bone substitute	2 (2,5)
Plastic Graft FGG	11 (13,8)
Plastic Graft CTG	27 (33,8)
Other Specification (in %)	N=80
Tunneling	12 (15)
CAF	7 (8,75)
Dental arcade (in %)	N=80
Superior	44 (55)
Inferior	36 (45)
Duration of surgery (average in minutes)	120

*Evaluation of Post-Operative Pain in Patients Submitted to Periodontal Surgical Treatments Using the Visual Analogue Scale*

Table 3 - Descriptive analysis of the Type of Surgery, Specification of the Type of Surgery, Other Specification, Dental Arcade and Duration of Surgery. EMD – emdoagain, GTR – guided tissue regeneration, FGG – free gingival graft, CTG – connective tissue graft, CAF – coronal advanced flap.

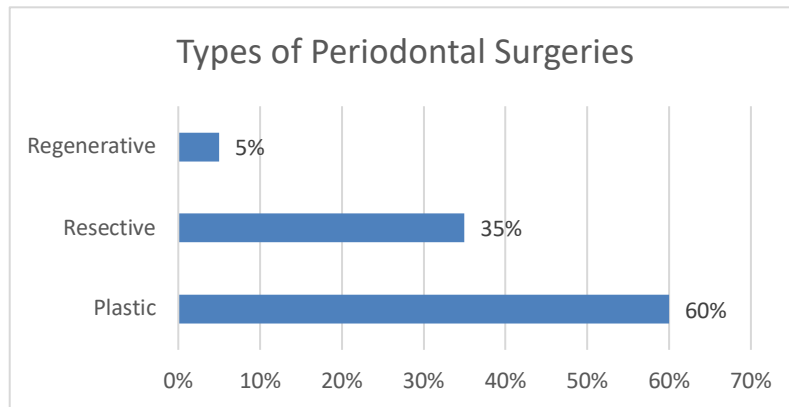


Chart 5 - Percentages of Periodontal Surgery Types

Antibiotics were prescribed for most of the patients (68.8%). It was amoxicillin that was used in 78.2% of the cases. Meanwhile, 31.3% of patients did not receive antibiotics.

Regarding analgesics/anti-inflammatories, 91.3% of patients took NSAIDs. The first-line treatment was ibuprofen 600 mg every 12 hours (98.6%). And 52,5% of patients took pain killers: paracetamol 1g. These data are described in Table 4.

Use of Antibiotic (in %)	N=80
No	25 (31,3)
Yes	55 (68,8)
Specification of Antibiotic (in %)	N=55
Amoxiciline 1g	43 (78,2)
Amoxiciline 875mg + Clavulanic Acid 125mg	4 (7,3)
Clarithromycin 500mg	3 (5,5)
Metronidazol 250mg	1 (1,8)
Azytromycin 500mg	1 (1,8)

Clindamicin 150mg	1 (1,8)
Ciprofloxacin 500mg	1 (1,8)
Use of NSAIDs (in %)	N=80
No	7 (8,8)
Yes	73 (91,3)
Specification of NSAIDs (in %)	N=73
Ibuprofene 600mg	72 (98,6)
Naproxen 500mg	1 (1,4)
Clonixin 300mg	2 (2,7)
Use of Pain killers (in %)	N=80
No	38 (47,5)
Yes	42 (52,5)
Paracetamol 1g	42 (100%)
Use of corticosteroids (in %)	N=80
No	79 (98,8)
Yes	1 (1,3)
Deflazacort 30mg	1 (100%)

Table 4 - Descriptive analysis of antibiotic use, antibiotic specification, NSAIDs use, NSAIDs specification, Painkillers use and Corticosteroids use; NSAIDs – Nonsteroidal Anti-Inflammatory Drugs.

Most patients complied with postoperative care instructions regarding consumption of soft, cold foods, not brushing the treated area, using chlorhexidine mouthwash/gel, and not practising physical exercise (Table 5). 21.3% of patients were habitual smokers; 70.6% of them continued to smoke after surgery, and 29.4% of the habitual smokers complied with the recommendation to quit smoking (Table 5).

Soft and cold food (in %)	N=80
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No	3 (3,8)
Yes	77 (96,3)
Absence of brushing in the treated area (in %)	N=80
No	2 (2,50)
Yes	78 (97,5)
Chlorhexidine Gel (in %)	N=80
No	24 (30)
Yes	56 (70)
Chlorhexidine mouthwash (in %)	N=80
No	7 (8,8)
Yes	73 (91,3)
Smoking Cessation (in %)	N=17
No	12 (70,6)
Yes	5 (29,4)
Absence of physical exercise (in %)	N=80
No	1 (1,3)
Yes	79 (98,8)

Table 5 - Descriptive analysis of Soft and Cold Food, Absence of Mechanical Control of bacterial plaque in the Treated Area, Chlorhexidine Gel and Mouthwash, Smoking Cessation and Absence of Physical Exercise

The average number of teeth treated by surgical procedures was approximately two.

According to the VAS, the highest pain intensity was observed on the first day (the day of surgery) at night, with a median of 3. The following day, the median values were less than or equal to 2. From the third day, the median values were less than or equal to 1,

with a value of approximately 0 observed on the day of suture removal, as can be seen in Table 6 and Chart 6.

Average	Teeth involved (number)	2,13 ± 1,47 (0-8)
Medians	Pain 1st Day Night	3,00 (5) (0-10)
	Pain 2nd Day Morning	2,00 (5) (0-10)
	Pain 2nd Day Afternoon	1,50 (5) (0-10)
	Pain 2nd Day Night	1,00 (5) (0-10)
	Pain 3rd Day Morning	1,00 (3) (0-8)
	Pain 3rd Day Afternoon	,50 (2) (0-9)
	Pain 3rd Day Night	1,00 (3) (0-8)
	Pain on Suture Removal Day	,00 (1) (0-8)

Table 6 - Descriptive analysis of the Average of Number of Teeth Involved, Median Pain 1st Night, Pain 2nd Morning, Pain 2nd Afternoon, Pain 2nd Night, Pain 3rd Morning, Pain 3rd Afternoon, Pain 3rd Night and Pain on Suture Removal Day

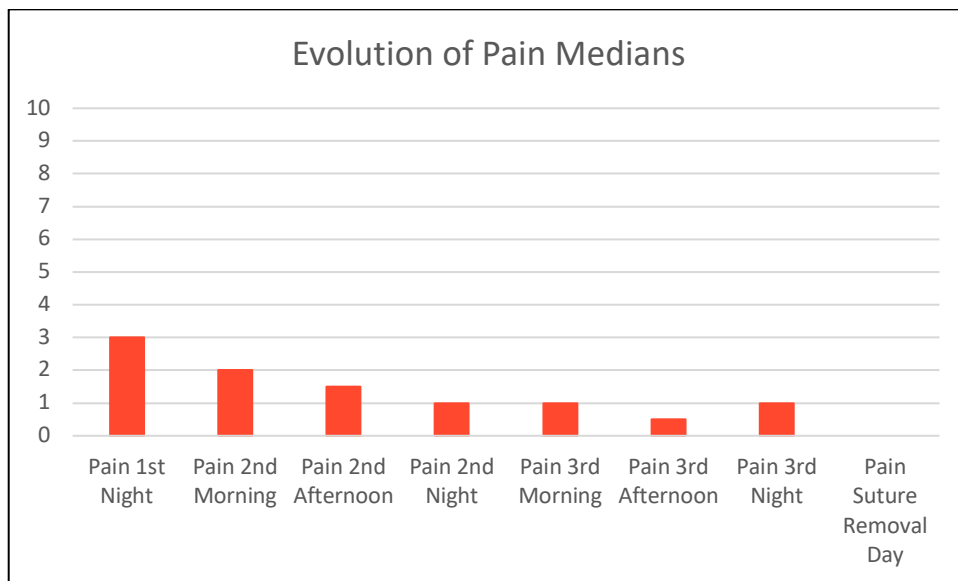


Chart 6 - The Evolution of Pain Medians

## 2. Inferential Statistics – Analysing the Relationship Between Pain and Other Variables

The relationship between pain and other variables was analysed using correlation analysis and hypothesis testing. A 5% significance level was used for all hypothesis testing. Factors such as obesity, gingivitis, type of regenerative surgery: with EMD, with EMD + bone substitute, GTR, corticosteroids use and absence of physical exercise were not taken

into account during the tests, due to the lack of patients with these characteristics in this investigation.

### **2.1. Relationship between Type of Periodontal Surgery and Pain**

After applying the Kruskal-Wallis test, relating pain at all times to the type of periodontal surgery, it was found that the level of pain does not vary with statistically significant differences at any time, depending on the type of periodontal surgery (Table 7).

	Pain (1st Day Night )	Pain (2nd Day Morning )	Pain (2nd Day After - noon )	Pain (2nd Day Night )	Pain (3rd Day Morning )	Pain (3rd Day After - noon )	Pain (3rd Day Night )	Pain (Suture Day)
H de	0,639	0,238	1,042	2,132	2,563	1,960	3,742	1,842
Kruskal-Wallis								
df	2	2	2	2	2	2	2	2
Significance Sig.	0,727	0,888	0,594	0,344	0,278	0,375	0,154	0,398

Table 7 - Kruskal-Wallis test comparing Daily Pain with the grouping variable: Type of Surgery

### **2.2. Relationship between Sex and Pain**

Pain from the 1st Day at Night and the 3rd Day at Night was used as a comparison.

The 1st Day at Night refers to the first 24 hours following surgery, which is a crucial time frame during which the effects of local anaesthesia have subsided, and the acute inflammatory response is starting to manifest. Because of early tissue damage, surgical stress, and the start of inflammation, patients may be experiencing the peak of nociceptive pain at this time.

The 3rd Day at Night represents a period greater than 48 hours after surgery. It is referenced as the time of greatest oedema and is a period during which the patient is already complying with postoperative care.

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0.014 on the 1st Day at Night. As (p) < 0,05, it indicates a statistical significant difference in pain between females and males on the first day. Females tend to feel a greater intensity pain than Males on the first day of surgery (Table 8).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0.110 on the 3rd Day at Night. As (p) > 0,05, it indicates no statistical significant differences in pain between females and males, on this day (Table 8).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	537,500	633,000
Wilcoxon W	1167,500	1263,000
Z	-2,445	-1,600
Significance Assit. (Bilateral)	<b>0,014</b>	0,110

Table 8 - Mann-Whitney test for comparison of Sex and Pain

### 2.3. Relationship between Smoking Habits and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0.413 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when smoking habits are considered (Table 9).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0.865 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when smoking habits are considered (Table 9).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	466,500	522,000
Wilcoxon W	2482,500	2538,000
Z	-0,818	0,170
Significance Assit. (Bilateral)	0,413	0,865

Table 9 - Mann-Whitney test for comparison of Smoking Habits and Pain

#### **2.4. Relationship between Diabetes and Pain**

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,373 on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when diabetes is considered (Table 10).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,805 on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when diabetes is considered (Table 10).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	112,000	141,500
Wilcoxon W	122,000	3067,500
Z	-0,891	-0,247
Significance Assit. (Bilateral)	0,373	0,805

Table 10 - Mann-Whitney test for comparison of Diabetes and Pain

#### **2.5. Relationship between Diseases with influence on the immune-inflammatory response and Pain**

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,699 on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when diseases with an influence on the immune-inflammatory response are considered (Table 11).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,344 on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when diseases with an influence on the immune-inflammatory response are considered (Table 11).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	201,000	173,500
Wilcoxon W	2976,000	2948,500
Z	-0,387	-0,946

Significance Assit. (Bilateral)	0,699	-0,344
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Table 11 - Mann-Whitney test for comparison of Diseases with influence on the immune-inflammatory response and Pain

## 2.6. Relationship between Depression and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,993 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when depression is considered (Table 12).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,682 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when depression is considered (Table 12).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	221,500	201,000
Wilcoxon W	2996,500	222,000
Z	-0,009	-0,410
Significance Assit. (Bilateral)	0,993	0,682

Table 12 - Mann-Whitney test for comparison of Depression and Pain

## 2.7. Relationship between Periodontitis and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,777 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when periodontitis is considered (Table 13).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,079 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when periodontitis is considered (Table 13).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	731,000	593,000
Wilcoxon W	1227,000	1818,000
Z	-0,284	-1,755
Significance Assit. (Bilateral)	0,777	0,079

Table 13 - Mann-Whitney test for comparison of Periodontitis and Pain

## 2.8. Relationship between the different Stages of Periodontitis and Pain

By applying the Kruskal-Wallis test, a significance (p) of 0,444 was obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the different stages of periodontitis regarding the experience of pain (Table 14).

By applying the Kruskal-Wallis test, a significance (p) of 0,180 was obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the different stages of periodontitis regarding the experience of pain (Table 14).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
H de Kruskal-Wallis	2,675	4,894
df	3	3
Significance Sig.	0,444	0,180

Table 14 - Kruskal Wallis Test for the comparison between the different Stages of Periodontitis and Pain

## 2.9. Relationship between the different Degrees of Periodontitis and Pain

By applying the Kruskal-Wallis test, a significance (p) of 0,277 was obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the different Degrees of Periodontitis regarding the experience of pain (Table 15).

By applying the Kruskal-Wallis test, a significance (p) of 0,329 was obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the different Degrees of Periodontitis regarding the experience of pain (Table 15).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
H de Kruskal-Wallis	2,568	2,221
df	2	2
Significance Sig.	0,277	0,329

Table 15 - Kruskal Wallis Test for the comparison between the different Degrees of Periodontitis and Pain

### 2.10. Relationship between the Superior and Inferior Arcades and Pain

By applying the Mann-Whitney U test, a significance (p) of 0,774 was obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the Superior and Inferior Arcades regarding the experience of pain (Table 16).

By applying the Mann-Whitney U test, a significance (p) of 0,542 was obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that no statistical significant differences were found between the Superior and Inferior Arcades regarding the experience of pain (Table 16).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	821,500	851,000
Wilcoxon W	1487,500	1517,000
Z	1	1
Significance Assist. (Bilateral)	0,774	0,542

Table 16 - Mann-Whitney Test for the comparison between Superior and Inferior Arcades and Pain

### 2.11. Relationship between Pain during Tunneling and Pain during CAF

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,168 on the 1st Day at Night. As  $(p) > 0,05$ , it indicates no statistical significant differences in pain between tunneling and CAF, on this day (Table 17).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,151 on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates no statistical significant differences in pain between tunneling and CAF, on this day (Table 17).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	19,500	19,500
Wilcoxon W	85,500	85,500
Z	-1,377	-1,436

Significance Assit. (Bilateral)	0,168	0,151
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Table 17 - Mann-Whitney test for comparison between Pain during Tunneling and Pain during CAF

## 2.12. Relationship between Use of Antibiotic and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,883 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of antibiotic is considered (Table 18).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,812 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of antibiotic is considered (Table 18).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	673,500	666.000
Wilcoxon W	998,500	2206,000
Z	-0,147	-0,238
Significance Assit. (Bilateral)	0,883	0,812

Table 18 - Mann-Whitney test for comparison of Use of Antibiotics and Pain

## 2.13. Relationship between Use of NSAIDs and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,725 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of NSAIDs is considered (Table 19).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,275 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of NSAIDs is considered (Table 19).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	235,000	195,500
Wilcoxon W	263,000	2896,500
Z	-0,352	-1,091
Significance Assit. (Bilateral)	0,725	0,275

Table 19 - Mann-Whitney test for comparison of Use of NSAIDs and Pain

### 2.14. Relationship between Use of Painkillers and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,831 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of painkillers is considered (Table 20).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,379 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of painkillers is considered (Table 20).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	776,000	712,500
Wilcoxon W	1679,000	1615,500
Z	-0,214	-0,879
Significance Assit. (Bilateral)	0,831	0,379

Table 20 - Mann-Whitney test for comparison of Use of Painkillers and Pain

### 2.15. Relationship between Use of chlorhexidine gel and mouthwash and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,664 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when the use of chlorhexidine gel is considered (Table 21).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,379 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when use of chlorhexidine gel is considered (Table 21).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	713,000	750,500
Wilcoxon W	2309,000	2346,500
Z	0,434	0,880
Significance Assit. (Bilateral)	0,664	0,379

Table 21 - Mann-Whitney test for comparison of Use of chlorhexidine gel and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,430 on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that there are no significant differences in pain when the use of chlorhexidine mouthwash is considered (Table 22).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,689 on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that there are no significant differences in pain when use of chlorhexidine mouthwash is considered (Table 22).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	209,500	233,500
Wilcoxon W	2910,500	2934,500
Z	-0,790	-0,400
Significance Assit. (Bilateral)	0,430	0,689

Table 22 - Mann-Whitney test for comparison of Use of chlorhexidine mouthwash and Pain

## **2.16. Relationship between Soft and cold food and Pain**

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,684 on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when soft and cold food is considered (Table 23).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,962 on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that there are no statistical significant differences in pain when soft and cold food is considered (Table 23).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	133,000	113,500
Wilcoxon W	3136,000	3116,500
Z	0,655	0,957
Significance Assit. (Bilateral)	0,684	0,962

Table 23 - Mann-Whitney test for comparison of Soft and Cold Food and Pain

### 2.17. Relationship between Absence of mechanical control in the intervened zone and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,444 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no significant differences in pain when the absence of mechanical control is considered (Table 24).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,914 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no significant differences in pain when the absence of mechanical control is considered (Table 24).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	104,500	82,000
Wilcoxon W	3185,500	3163,000
Z	0,410	0,895
Significance Assit. (Bilateral)	0,444	0,914

Table 24 - Mann-Whitney test for comparison of Absence of mechanical control gel and Pain

### 2.18. Relationship between Smoking cessation and Pain

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,488 on the 1st Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when smoking cessation is considered (Table 25).

The nonparametric Mann-Whitney U test yielded a significance level (p) of 0,790 on the 3rd Day at Night. As (p) > 0,05, it indicates that there are no statistical significant differences in pain when smoking cessation is considered (Table 25).

	Pain (1st Day at Night)	Pain (3rd Day at Night)
U de Mann-Whitney	357,000	426,500
Wilcoxon W	2703,000	2772,500
Z	-0,693	0,226
Significance Assit. (Bilateral)	0,488	0,790

Table 25 - Mann-Whitney test for comparison of Smoking cessation and Pain

### 3. Correlation of quantitative variables

#### 3.1. Nonparametric correlation between Age and Pain.

Using Spearman's rho test, a correlation coefficient of -0.137 and a significance (p) of 0,225 were obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with age on this day (Table 26).

Using Spearman's rho test, a correlation coefficient of -0.027 and a significance (p) of 0,815 were obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with age on this day (Table 26).

			Pain (1st Day at Night)	Pain (3rd Day at Night)
Spearman's rho	Age	Correlation coefficient	-0,137	-0,027
		Sig. (bilateral)	0,225	0,815
		N	80	80

Table 26 - Spearman's rho test for comparison between Age and Pain

#### 3.2. Nonparametric correlation between Extent of the surgical site (number of teeth) and Pain.

Using Spearman's rho test, a correlation coefficient of 0.112 and a significance (p) of 0,322 were obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the number of teeth involved on this day (Table 27).

Using Spearman's rho test, a correlation coefficient of 0.160 and a significance (p) of 0,155 were obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the number of teeth involved on this day (Table 27).

			Pain (1st Day at Night)	Pain (3rd Day at Night)
Spearman's rho	Number of teeth	Correlation coefficient	0,112	0,160
		Sig. (bilateral)	0,322	0,155

		N	80	80
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Table 27 - Spearman's rho test for comparison between Number of teeth and Pain

### 3.3. Nonparametric correlation between Duration of Surgery and Pain.

Using Spearman's rho test, a correlation coefficient of 0.052 and a significance (p) of 0,648 were obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the duration of surgery on this day. Using Spearman's rho test, a correlation coefficient of 0.183 and a significance (p) of 0,104 were obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the duration of surgery on this day (Table 28).

			Pain (1st Day at Night)	Pain (3rd Day at Night)
Spearman's rho	Duration of Surgery	Correlation coefficient	0,052	0,183
		Sig. (bilateral)	0,648	0,104
		N	80	80

Table 28 - Spearman's rho test for comparison between Duration of Surgery and Pain

### 3.4. Nonparametric correlation between Duration of NSAIDs and Pain.

Using Spearman's rho test, a correlation coefficient of 0.026 and a significance (p) of -0,115 were obtained on the 1st Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the duration of NSAIDs on this day (Table 29).

Using Spearman's rho test, a correlation coefficient of 0.817 and a significance (p) of 0,310 were obtained on the 3rd Day at Night. As  $(p) > 0,05$ , it indicates that pain does not vary with the duration of NSAIDs on this day (Table 29).

			Pain (1st Day at Night)	Pain (3rd Day at Night)
Spearman's rho	Duration of NSAIDs	Correlation coefficient	0,026	-0,115
		Sig. (bilateral)	0,817	0,310

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		N	80	80
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*Table 29 - - Spearman's rho test for comparison between Duration of NSAIDs and Pain; NSAIDs – Nonsteroidal Anti-Inflammatory Drugs*

## **V. DISCUSSION**

The main objective of this study was to evaluate postoperative pain in patients undergoing periodontal surgery and identify factors that may influence its intensity. This work is a continuation of the investigation conducted by Ribeiro (2018) as part of his thesis for the Master's degree in Dentistry, by adopting the initial methodology while making several improvements.

The study was conducted at the same University, at the Egas Moniz Dental Clinic, using an identical protocol, but seven years apart. The innovations include the integration of new medical variables, including systemic diseases such as diabetes, immunoinflammatory pathologies, obesity, and depression, and the analysis of new surgical variables, particularly the comparison between the coronally advanced flap (CAF) technique and the tunnelling technique. Furthermore, the most recent periodontal classification (2017) was used, allowing for a more precise stratification of the disease according to its stages and grades.

Another significant methodological difference lies in the assessment of pain. While Ribeiro (2018) made his comparisons solely based on pain levels measured on the evening of the third post-surgical day (D3 evening), in the current study the pain intensities were examined at two crucial time points: the first evening (D1 evening) and the third evening (D3 evening). This combined approach offers a more dynamic overview of the progression of postsurgical pain, taking into account both the initial stage of the acute inflammatory response and the period when oedema is generally maximal.

Dentists and students enrolled in the Postgraduate Program in Periodontology, the Postgraduate Specialization Program in Periodontology, and in Periodontal Assistance consultations performed the periodontal procedures. The surgical procedures were not performed by the same surgeons, so variations in tissue handling and material use are possible.

Questionnaires were administered by the student in charge of the study, collecting demographic information, details of the surgical procedure, and information on pain. The first part of Questionnaire 1 collected information regarding age, sex, smoking, medical conditions, periodontal disease, and the nature and duration of the procedure. The second

part of Questionnaire 1 concerned compliance with medications and postoperative care. The patient received Questionnaire 2, designed to measure postoperative pain, on the day of surgery. Between the day of surgery and the day the sutures were removed, the patient was required to complete a set of eight visual analog scales, which were then returned to the student on the last day.

The results obtained allow us to discuss the null hypothesis (H<sub>0</sub>) according to which the intensity of post-operative pain is independent of factors such as age, smoking, pathologies (diabetes, immuno-inflammatory pathologies, obesity and depression), periodontal disease, type of periodontal surgery (resective, regenerative and plastic), technique used, teeth involved, duration of the intervention, medication prescribed and post-operative care..

This study included a sample of 80 patients, 56.3% women and 43.8% men, with a mean age of 52.31 years (ranging from 18 to 82). Between February and June 2025, they underwent procedures including resective, regenerative, and plastic surgeries, with a mean operating time of 120 minutes. Only sex showed a statistical significant influence on pain intensity on the first evening of surgery.

In the present study, postoperative pain was characterized by a peak intensity on the first evening (D1 evening), with a median value of 3.00 on the VAS scale (0-10). A gradual decrease was then observed: D2 morning (2.00), D2 afternoon (1.50), D2 evening (1.00), D3 morning (1.00), D3 afternoon (0.50), D3 evening (1.00), and an almost complete reduction in pain on the day of suture removal (0.00).

According to Ribeiro (2018), the profile is different. Although the peak is also observed on the day of surgery with a median of 6.9, he reported a further increase on the evening of the second day with a median of 6.13 compared to 5.90 in the afternoon. He attributed this resurgence of pain to the occurrence of peak oedema, generally observed between 48 and 72 hours after surgery (Ribeiro, 2018). In the present study, this stage did not cause a significant increase in pain, indicating that local inflammation was not substantial enough to alter pain sensation and scores overall show lower levels of pain. This difference could be explained by the fact that the present study involved surgeries performed by students with greater experience in the speciality of Periodontology.

Our data are consistent with other scientific publications. Durand et al. (2013), for instance, reported that pain reaches its highest level during the first three days after surgery and then gradually decreases. Tan et al. (2014) showed a score of 2,1 on the first day, a decrease to 1,0 on the third day and reaching a median of 0,0 on the 7<sup>th</sup> day. Mounssif et al. (2023) presented a VAS score of 2,96 on day 7 after surgery. Thus, several studies have reported median pain levels within the low range, hence providing evidence-based clarification of the concerns that some patients may have before undergoing this type of procedure.

In the present study, the only element that showed a significant association with pain level was sex, with  $p = 0.014$ . Higher scores were noted in women on the first evening (D1 evening). This observation is corroborated by several studies showing that, in general, postoperative pain affects women more (Fillingim et al., 2009; Mogil, 2012; Eltumi & Tashani, 2017). This difference can be explained by various mechanisms: modulation of nociception by hormones, the impact of hormonal cycles, psychosocial factors, and fluctuations in pain perception and tolerance threshold.

Although our protocol corresponds to that of Ribeiro (2018), the latter did not reveal a significant difference based on sex, which could be attributed to sampling variations or the inclusion of new assessment times. Indeed, Ribeiro only used pain levels from the third day at night.

Other patient-related factors, such as age, smoking habits, and medical conditions, did not show a significant relationship with postoperative pain on the first day at night and the third day at night.

In our research, age ( $p > 0.05$ ) was not found to have a statistically significant association with postoperative pain severity at any assessment time. This result differs from that reported by Ribeiro (2018), who observed less intense pain in older patients. According to the literature, aging alters pain perception in a nuanced way. According to Gibson & Farrell (2004) the pain threshold seems to rise for short-term and localised stimuli. However, pain can persist longer if the stimuli are powerful or widespread. In older people, the rehabilitation of the nociceptive system is slower, which can extend hyperalgesia, a high sensitivity to pain after the injury, beyond the healing phase. Thus, age appears to influence, rather than determine, postoperative pain in periodontology

(Gibson & Farrell, 2004). Other studies, such as that of Mounssif et al. (2023), also find no significant link between age and postoperative pain.

We found no statistically significant difference between smoking and non-smoking patients regarding postoperative pain severity. However, Ribeiro (2018) demonstrated a significant correlation ( $p < 0.01$ ): patients who smoked reported higher levels of pain than those who did not. This discrepancy could be attributed to the influence of tobacco on the regulation of the inflammatory response and the healing process (Shi et al., 2010). The issue remains controversial in the scientific field: although many studies indicate an intensification of postoperative pain in smokers, others, such as Mounssif et al. (2023), do not present an association between smoking and postoperative pain intensity.

In the present study, no association ( $p > 0.05$ ) was found between the presence of diabetes and increased postoperative pain intensity. There was no statistically significant difference between diabetic and non-diabetic patients. Ribeiro (2018) did not take this variable into account, which represents one of the methodological innovations of this research. From a pathophysiological perspective, diabetes is often associated with peripheral neuropathy, which can alter the nociceptive perception threshold (Schreiber, 2015; Coulibaly, 2024). These effects are generally more pronounced when diabetes is poorly controlled. Indeed, since patients who undergo periodontal surgery already have an obligation to have controlled diabetes, it could explain the similarity in pain levels observed between the two groups.

In the context of the investigation, the presence of immuno-inflammatory pathology did not show a significant association with postoperative pain intensity ( $p > 0.05$ ). Ribeiro (2018) did not examine this variable, making it another innovative element of our protocol. Immuno-inflammatory diseases can affect the response to pain. Indeed, a weakened immune system leads to changes in inflammation, thus decreasing the perception of pain and increasing the duration of periods of pain due to delayed healing (Page, 2005). However, in our study, most diseases were controlled through treatment. Surgical procedures were thus performed in a controlled environment, minimizing excessive inflammation.

Regarding obesity, although this parameter was noted during data collection, the small number of patients included in our sample did not allow for appropriate statistical

analyses. Due to the high inflammatory status of the disease, various studies indicate that obesity may be linked to increased sensitivity to postoperative pain (Galassi, 2025). Future research on larger groups could clarify this link in the context of periodontal surgery.

No statistically significant association was found between postoperative pain severity and the presence of depressive disorders. This finding may be due to the rarity of this factor in our population. However, studies frequently report a link between depression and increased pain sensitivity. Indeed, depression reduces the effectiveness of the internal pain regulation process (Klauenberg et al., 2008), due to changes in responses to noxious stimuli (Berna et al., 2010). Moreover, Edwards et al. (2009) emphasise that depressive symptoms predict greater postsurgical pain intensity.

Furthermore, the presence of periodontitis, with different stages and degrees, did not show a significant difference in postoperative pain. Our research found no significant association between the presence of periodontitis and a notable difference in postoperative pain, regardless of the time of assessment. This result is similar to Ribeiro (2018), who also found no significant difference between this variable and pain. This finding is consistent with several studies suggesting that pain intensity following periodontal surgery is more related to technical factors, such as the type of periodontal surgery performed (Mei et al., 2026). Furthermore, other research on periodontal pain has not examined the perception of pain associated with periodontal disease (Gufran et al., 2023).

Furthermore, our study also does not show a significant impact of the stages and degrees of periodontitis on postoperative pain. This result is consistent with the literature, which shows that using the VAS pain scale, these factors have no statistically significant relationship with postoperative pain (Gufran et al., 2023).

To continue, surgical factors, such as the type of surgery, surgical technique, dental arch, extent of the surgical area, and duration of surgery, are not significantly related to the intensity of pain experienced after surgery.

Indeed, the type of surgery had no statistical significance in our study regarding pain intensity, either on the evening of the first or third postoperative day. This observation is

consistent with the study by Ribeiro (2018) and Mounssif et al. (2023). Thus, the literature suggests that the type of periodontal intervention does not significantly influence postoperative pain, especially when surgical procedures and analgesics are standardised.

The comparison between the tunnelling method and the coronal advanced flap (CAF) did not reveal any statistically significant difference in pain intensity at D1 evening ( $p = 0.168$ ) and D3 evening ( $p = 0.151$ ). These findings are consistent with those of Ribeiro (2018), who also noted no significant difference in pain perception between surgical specifications when performed under comparable clinical conditions. These findings are consistent with a recent meta-analysis by Cheng et al., published in the *West China Journal of Stomatology* (2023). This study, which compared the CAF method combined with connective tissue grafting and the tunnelling technique combined with connective tissue grafting, found no statistically significant difference in pain scores assessed by the visual analog scale ( $p = 0.68$ ). This information indicates that, although these methods have technical and biological differences, the postoperative pain experience is generally similar when both procedures are performed in a controlled clinical environment and according to an appropriate pain management protocol.

In the present investigation, no significant difference was found between the upper and lower arches in terms of pain intensity during the D1 evening and D3 evening periods. Ribeiro's (2018) results support this observation, also reporting no significant difference depending on the arch treated. Another study on postoperative pain after periodontal surgery presents the same results, indicating that, in the context of periodontal intervention, the anatomical location (maxillary or mandibular) is probably not a determining factor in postoperative pain (Mounssif et al., 2023).

No relationship was found between the extent of the surgical site, the number of teeth involved in the surgery, and the pain experienced during the D1 evening and D3 evening periods. Ribeiro (2018) also found no significant difference during more extensive surgery. Despite this, the findings of Mounssif et al. (2023) are different. Indeed, according to this study, a surgical extension larger than three teeth was associated with an increase in postoperative pain symptoms (Mounssif et al., 2023). This disparity may be attributed to better pain management.

The duration of the surgical procedure did not demonstrate a significant association with the level of postoperative pain, either on the evening of the first day or the evening of the third day. This result correlates with those of Ribeiro (2018) and Mounssif et al. (2023), who did not find a significant relationship between the duration of surgery and pain intensity. However, the literature tends to show that the longer the surgery, the greater the intensity of pain after surgery (Lago-Méndez, 2007). In our situation, standardised methods, technical expertise, and the use of appropriate pain medications likely mitigated the impact of procedure duration on reported pain.

Furthermore, according to our study, postoperative factors also did not influence pain on the evening of day 1 or the evening of day 3.

Indeed, the administration of postoperative antibiotics did not significantly influence pain intensity on the evening of day 1 or the evening of day 3. This finding is consistent with the results of Miguel (2018) and the work of Mounssif et al. (2023). This lack of effect can be attributed to the fact that antibiotics do not have direct analgesic properties. Their function is related to the prevention or management of postoperative infections.

In the present study, postoperative NSAID use did not cause any significant change in pain intensity on the evening of day 1 or the evening of day 3. These results are contrary to the literature. Indeed, according to Isiordia Espinoza et al. (2023), selective COX-2 inhibitors contribute to a significant reduction in postoperative pain. Furthermore, Ribeiro (2018) also found a relationship between this factor and pain. He also found a strong correlation between the duration of NSAID use and pain. The more intense the pain, the longer the duration of NSAID use. A difference in the profile of the patients compared to published studies may explain the discrepancy.

The use of analgesics, such as paracetamol, did not demonstrate a significant link with pain severity on the evening of D1 or the evening of D3. This observation differs from several sources that typically indicate that more frequent or extensive use of painkillers is observed in patients reporting high pain levels (Ribeiro, 2018; Gufran et al., 2023). In our research, reported pain was already low, limiting the ability to detect a specific difference between analgesics in pain levels.

The use of chlorhexidine, whether in gel or mouthwash form, did not demonstrate a significant association with pain intensity on the evening of D1 or the evening of D3. Furthermore, other studies such as Ribeiro (2018) and De Nuria Romeo-Olid et al. (2023) had the same result. This finding indicates that in the context of periodontal surgery, the use of chlorhexidine does not influence postoperative pain intensity. The lack of association in our patient group may be due to the standardised postoperative protocol, which included effective pain-relieving and anti-inflammatory treatments, potentially masking any discrepancies related to chlorhexidine use.

No significant correlation was observed between a soft, cold diet and the lack of mechanical control in the surgical area, with pain intensity assessed on the first and third nights. Mani et al. (2021) emphasise the importance of a strict postoperative protocol to facilitate healing, minimise the risk of complications, and thus reduce the risk of pain. The fact that in our group of patients an effect on pain was not observed could be due to the uniformity of care received by all patients, reducing the possible variations associated with these treatments.

Finally, smoking cessation also did not show a significant relationship with pain intensity. Unlike us, Ribeiro (2018) established a relationship between these factors on the third night of the day. He demonstrated that patients who quit smoking after surgery experienced less postoperative pain on the third night than patients who continued to smoke. The lack of correlation could be due to the rigorous standardisation of postoperative care, which could have reduced disparities between groups.

Thus, our research methodically examined demographic, clinical, surgical, and behavioural factors likely to affect the extent of pain after periodontal surgery.

Although most of the associations examined did not demonstrate statistical significance, this comprehensive methodology offers the opportunity to precisely detail which factors appear to have limited influence in current operating conditions, characterised by less invasive methods and standardised medication management. Even though most of the associations examined did not demonstrate statistical significance, this comprehensive methodology allows us to see precisely that sex is the factor that had a significant influence on postoperative pain. This finding coincides in some aspects with the

conclusions of previous research, while differing in others, likely due to methodological differences or associated with the characteristics of the population analysed.

A significant weakness of this research is the uneven distribution of the criteria examined, such as the type of surgery and the diseases presented by the patients. Another limitation is the lack of rigour in the use of VAS scales, thus exposing a bias in the measurement. The lack of rigorous supervision of the timing of medication intake and pain assessment could have influenced the reported intensity.

In the future, multicentre research involving larger samples, extended follow-up, and standardised collection of psychosocial variables could deepen our knowledge of the factors influencing postoperative pain in periodontology and help refine prevention and treatment strategies.



## **VI. CONCLUSION**

Our results show that periodontal surgical procedures, as measured by the VAS scale, have a minor influence on patients' quality of life. The post-operative pain generally lasts less than 7 days, and the median pain scores do not exceed 3 out of 10. This information is very important because it helps to clarify in a more sustained manner the acceptance of some patients who may feel some apprehension before this type of surgery. Furthermore, these findings allow us to conclude that the periodontal surgeries performed at the Egas Moniz Dental Clinic are conducted with great skill and offer patients post-operative comfort.

This study also aimed to assess factors that can influence the severity of postoperative pain, evaluated on the first and third evenings after periodontal surgery. The protocol, carried out on a sample of 80 patients, showed that only gender had a significant association with pain on the first evening. This finding, supported by existing literature, indicates that women tend to experience more pain than men at this assessment point. Therefore, this research enhances understanding and supports improved patient care.

There are many studies on this topic in the literature. However, it remains essential to continue research to deepen our understanding of post-operative pain. It could also be valuable to assess the socio-economic impact on post-surgical pain.

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## APPENDIX



### Comissão de Ética EGAS MONIZ

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Processo Interno: 1558  
PT-397/24

Ex.ma Senhora  
Maaria Khan Domun

Monte de Caparica, 5 de fevereiro de 2025.

Ex.ma Senhora,

Em resposta ao Pedido de Parecer que submeteu à apreciação da Comissão de Ética da Egas Moniz, com o tema denominado: "Avaliação da dor pós-operatória em pacientes sujeitos a tratamentos cirúrgicos periodontais através da escala visual analógica ", foi aprovado condicionalmente.

Corrigir nome da UC no consentimento.

No questionário trocar género por sexo se quer manter M/F.

A Vice-Presidente da Comissão de Ética da Egas Moniz



Profª Doutora Ângela Pereira

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Comissão de Ética EGAS MONIZ

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Processo Interno: 1558

PT-397/24

Ex.ma Senhora

Maaria Khan Domun

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Monte de Caparica, 30 de abril de 2025.

Ex.ma Senhora,

Em resposta ao Pedido de Parecer que submeteu à apreciação da Comissão de Ética da Egas Moniz, com o tema denominado: "Avaliação da dor pós-operatória em pacientes sujeitos a tratamentos cirúrgicos periodontais através da escala visual analógica ", foi aprovado.

A Presidente da Comissão de Ética da Egas Moniz



Profª Doutora Ana Filipa Vicente

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EGAS MONIZ SCHOOL  
of HEALTH & SCIENCE

## Consentimento Informado

Código | IMP-EM-PE-17\_03

Monte de Caparica, de \_\_\_\_\_ de 2024/25

Exmo.(a) Sr.(a),

No âmbito do Mestrado Integrado em Medicina Dentária, na Unidade Curricular de Orientação Tutorial de Projeto Final, sob a orientação do Prof. Doutor José Maria Cardoso, solicita-se autorização para a participação no estudo de “Avaliação da dor pós-operatória em pacientes sujeitos a tratamentos cirúrgicos periodontais através da escala visual analógica”, com o objetivo de analisar a relação entre a dor e diferentes fatores no período pós-operatório. A participação no estudo consiste no preenchimento do questionário com escala visual analógica nos 3 dias seguintes da cirurgia, bem como, no dia da remoção da sutura. Esse questionário deverá ser entregue ao aluno que irá remover a sutura.

A participação neste estudo é voluntária. A sua não participação não lhe trará qualquer prejuízo. Este estudo pode trazer benefícios tais como estabelecer um melhor conhecimento da dor pós-operatória em periodontologia, ajudando assim ao progresso do conhecimento.

A informação recolhida destina-se unicamente a tratamento estatístico e/ou publicação e será tratada pelo(s) orientador(es) e/ou pelos seus mandatados. A sua recolha é anónima e confidencial.

*(Riscar o que não interessa)*

**ACEITO/NÃO ACEITO** participar neste estudo, confirmando que fui esclarecido sobre as condições do mesmo e que não tenho dúvidas.

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*(Assinatura do participante ou, no caso de menores, do pai/mãe ou tutor legal)*

Data : / /

### Questionário 1 (1ª Parte)

(A preencher pelo aluno responsável pela tese)

Preencha com uma cruz (X) ou com a informação pedida.

<b>Idade</b>	<input type="text"/>		
<b>Sexo</b>	<input type="text" value="M"/>	<input type="text" value="F"/>	
<b>Hábitas Tabágicos</b>	<input type="text" value="Sim"/>	<input type="text" value="Não"/>	<input type="text" value="Média de cigarros por dia"/>
<b>Doenças</b>			
Diabetes	<input type="text" value="Sim"/>	<input type="text" value="Não"/>	<input type="text" value="Se sim, é controlado ?"/>
Doença com influência na resposta imuno-inflamatório	<input type="text" value="Sim"/>	<input type="text" value="Não"/>	<input type="text" value="Se sim, qual ?"/>
Obesidade	<input type="text" value="Sim"/>	<input type="text" value="Não"/>	
Depressão	<input type="text" value="Sim"/>	<input type="text" value="Não"/>	
<b>Doença Periodontal</b>			
Gengivite	<input type="text"/>		
Periodontite:			
Estadio I	<input type="text"/>	Grau A	<input type="text"/>
Estadio II	<input type="text"/>	Grau B	<input type="text"/>
Estadio III	<input type="text"/>	Grau C	<input type="text"/>
Estadio IV	<input type="text"/>		

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**Tipo de cirurgia**

Rresetiva

Regeneradora

EMD

EMD + Substituto ósseo

RTG

RTG + Substituto ósseo

Plástica

EGL

ETCS

Técnica realizada :

---

---

Dentes envolvidos :

---

Duração da cirurgia (em minutos):

---

Data :    /    /

### **Questionário 1 (2ª Parte)**

(A preencher pelo aluno responsável pela tese ou alunos da Pós-graduação de Periodontologia)

**Preencha com uma cruz (X) ou com a informação pedida.**

#### **Cuidados pós-operatórios prescritos :**

(Parte do questionário a realizar no dia remoção da sutura)

#### **Medição prescrita**

Antibiótico	<input type="checkbox"/> Sim <input type="checkbox"/>	Qual <input type="text"/>	Duração <input type="text"/>
	<input type="checkbox"/> Não <input type="checkbox"/>		
AINE	<input type="checkbox"/> Sim <input type="checkbox"/>	Qual <input type="text"/>	Duração <input type="text"/>
	<input type="checkbox"/> Não <input type="checkbox"/>		
Outro	<input type="checkbox"/>	Qual <input type="text"/>	Duração <input type="text"/>

#### **Controlo químico da placa bacteriana**

Gel Clorhexidina	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>
Colutório de Clorhexidina	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>

#### **Outros cuidados pós-operatórios**

Alimentação mole e fria – 48h	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>
Ausência de control mecânico na zona intervencionada	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>
Interrupção do hábito tabágico até à remoção da sutura	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>
Ausência do exercício físico	<input type="checkbox"/> Sim <input type="checkbox"/>	<input type="checkbox"/> Não <input type="checkbox"/>

Data:    /    /

## Questionário 2

(A preencher pelo paciente)

A Escala Visual Analógica consiste numa linha horizontal, ou vertical, com 10 centímetros de comprimento, que tem assinalada numa extremidade a classificação “Sem dor” e, na outra, a classificação “Máxima dor possível”.

**Preencha a Escala Visual Analógica hoje e nos próximos 2 dias da manhã, à tarde e à noite bem como o dia de remoção da sutura com um traço perpendicular à linha, no ponto que representa a intensidade da sua dor.**

**1º Dia (dia da cirurgia) :**

Noite :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

**2º Dia :**

Manhã :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

Tarde :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

Noite :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

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**3° Dia :**

Manhã :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

Tarde :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

Noite :

\_\_\_\_\_

Sem dor Máxima  
Dor possível

**Dia da remoção da sutura :**

\_\_\_\_\_

Sem dor Máxima  
Dor possível