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Orthodontic pain

A Project Submitted to

The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled "Orthodontic pain " was prepared by the fifth-year student Shahad Raad Hashim under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Date :

DEDICATION

To my beloved parents, sister, and brother who have always been my source of inspiration and strength, thank you for supporting me through this and teaching me to always have faith and believe in myself.

Shahad Raad

Acknowledgment

First, I thank **"Allah"** almighty for granting me the will and strength to accomplish this project and I pray that his blessings upon me may continue throughout my life.

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List of Abbreviations

RCT	Recent Randomized Controlled Trial
RME	Rapid Maxillary Expansion
VRS	Verbal Rating Scales
VAS	Visual Analogue Scale
MPQ	McGill Pain Questionnaire
NSAIDs	Non Steroidal Anti Inflammatory Drugs
LLLT	Low Level Laser Therapy
TENS	Transcutaneous Electrical Nerve Stimulation
CBT	Cognitive Behavioral Therapy
CGRP	Calcitonin Gene-Related Peptide

Introduction

Pain is described as actual or potential damage of the tissue with objectionable sensory and emotional experience. In the affected teeth, orthodontic pain is felt as dull pain and hypersensitivity in all cases. It is the most mentioned negative effect and complex experience that results from orthodontic treatment, and is the main reason for stopping orthodontic treatment and is therefore a major issue for patients as well as orthodontists. **(Kavaliauskiene *et al.*, 2012; Asiry *et al.*, 2014).**

Orthodontic pain may refer to any painful sensation such as a gingival lesion, mucosal ulcer, and tongue discomfort caused by orthodontic appliances. It is usually described as tooth discomfort induced by orthodontic tooth movement . However, because human beings are well acquainted with the fact that orthodontic pain is a normal adverse effect of tooth movement, orthodontic pain is well accepted by most orthodontic patients **(Rakhshan H and Rakhshan V, 2015; Rennick *et al.*, 2016).**

Pain and discomfort have been reported to be experienced by up to 95% of orthodontic patients and can be felt at all stages of treatment. This includes early interceptive extractions, the placement of separators, bands, archwires and, finally, at debond and retainer fit. **(Mangnall *et al.*, 2013).**

Pain, which is one of the major deterrents for patient compliance for orthodontic treatment. Studies have revealed that pain is among the most frequently reported negative effects of orthodontic treatment and even when compared to the pain of invasive procedures such as extractions, patients perceived orthodontic pain to be greater in both incidence and severity. Patients undergoing orthodontic treatment experience varying degrees of discomfort which may be as a result of tension , functional restrictions or psychological aversion to wear the appliance in the public. Patient compliance is directly related to the discomfort experienced by the patient during orthodontic treatment. Patients undergoing fixed orthodontic treatment have reported greater pain and discomfort than the patients with removable plates. **(Glick et *al.*, 2009).**

Aim of Study

This review was prepared to highlight the different potential causes of orthodontic pain as well as its characteristics and mechanisms and to discuss the different measures that can be taken to manage the pain experienced by patients during treatment.

Chapter One : Review of literatures

1.1 Characteristics of Orthodontic Pain

Pain sensation and masticatory discomfort are the most common side effects of orthodontic treatment. For efficient patient compliance and favorable outcomes, the orthodontist should inform patients about these aspects before starting treatment and should evaluate their motivation and potential risks. Moreover, it is ethically important to inform the patient about potential side effects of treatment, and it should be part of the patient's informed consent **(Bucur *et al*.,2014).**

It can be felt during almost all orthodontic procedures: from placement of separator, banding, arch wire insertion and activation using elastics, orthopedic forces, rapid maxillary expansion and .debonding procedures **(Tuncer *et al.*, 2011; Mangnall *et al.*, 2013; Panda *et al.*, 2015)**

This subjective feeling is often expressed as sensation of pressure, tension and soreness by patients. Previous research has indicated that the type of pain is usually mild to moderate in nature, starts two hours after orthodontic appliance placement, peaks at 24 hours after appliance activation and lasts for about five to seven days, with the pain occurring on exertion such as during mastication **(Johal *et al*., 2018; Costa *et al*., 2020).**

Pain can have a negative impact on quality of life related to oral health, as a high level of pain can affect compliance which may affect the patient's relationship with the practice and lead to early termination of orthodontic treatment **(Brown and Moerenhout,. 1991; Antonio-Zancajo *et al.*, 2020)**.

Orthodontic pain can result in anxiety among patients, and this would in turn exacerbate the pain among them. A survey data collected from orthodontic providers revealed that most orthodontists were not aware that their patients had taken pain medication to ameliorate pain caused during treatment, and unsurprisingly underestimated their patients' pain level . It is therefore crucial for clinicians to understand mechanism of orthodontic pain, factors influencing pain perception and finally appropriate pain, management for their patients **(Seers *et al.*, 2018).**

1.2 Mechanisms of Orthodontic Pain

Once orthodontic forces are applied on teeth, inflammatory reactions which will stimulate the release of different biochemical mediators in the periodontium and dental pulp, causing the sensation of pain, vascular, cellular, neural and immunological reactions, respond in a coordinated form to eventually result in pain and tooth movement. Tooth movement and orthodontic pain happen to be two biological episodes that are interconnected and dependent with local inflammation being their mode of action **(Sacerdote and Levrini, 2012; Chavarría-Bolaños *et al.*, 2014)**

During local inflammation, products such as prostaglandin and bradykinin act on sensory endings to promote painful sensations. Therefore, the mechanisms underlying orthodontic pain lie in periodontal inflammatory responses induced by orthodontic forces. The periodontal inflammation response includes three components: vascular, cellular and chemical events. The three components interact with each other and form a network **(Wang *et al.*, 2005; Nimeri *et al.*, 2013)**.

The mechanisms of orthodontic pain are illustrated in **Figure 1.**

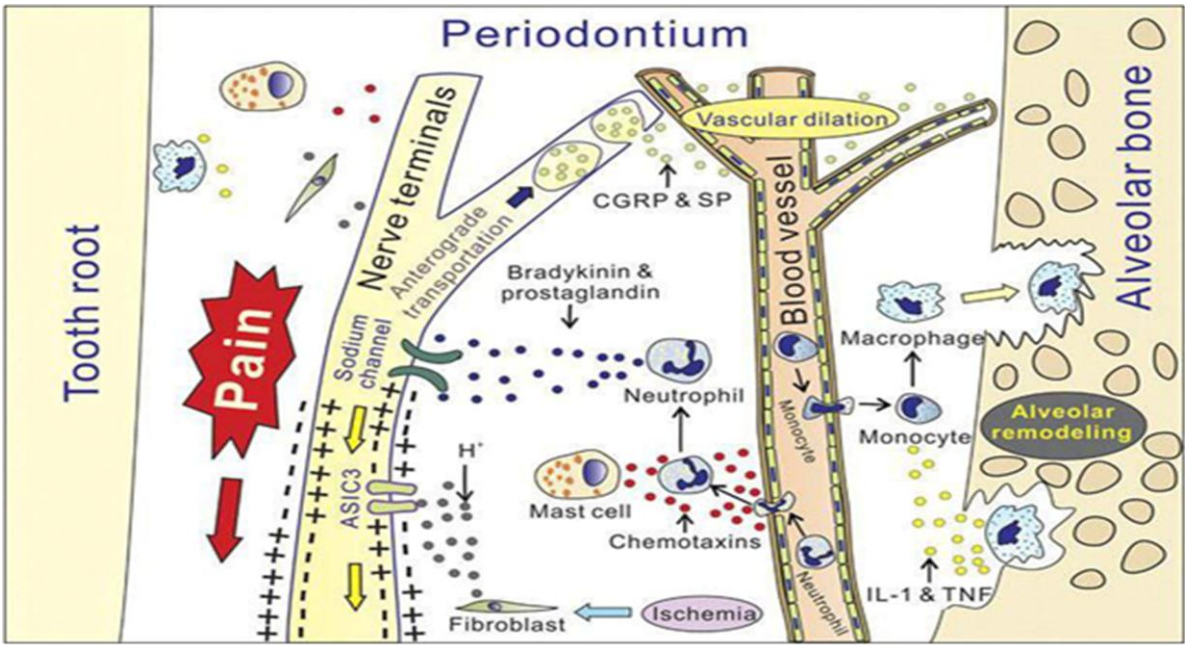

Fig 1: The mechanisms underlying orthodontic pain (Hu Long *et al.*, 2016)

1.3 Factors Influencing Pain Perception

The degree of pain experienced by individuals in response to an identical noxious stimulus can vary greatly from person to person and it may be influenced by a number of different factors **(Jerjes *et al.*, 2015)** :

1.3.1 Gender

The effect of gender on pain perception is mixed. At the time of appliance or separator placement, with one meta- analysis revealed females displayed greater pain sensitivity than males **(Mcdougall *et al.*, 2021)** ,

Raak *et al.* (2022) argued that there was no gender differences following initial arch wire placement .

1.3.2 Age

There appear to be conflicting findings with regard to age differences in orthodontic pain experience, this may be due to various treatment approaches .Several orthodontic studies reported that the older the patient, the greater the pain reported , and most would prefer to believe that Adolescents undergoing orthodontic treatment report higher levels of pain than do preadolescents and adults **(Bradley et al., 2007; Bergius et al., 2008).**

1.3.3 Ethnicity

Pain coping styles are different across different ethnicities, with one meta-analysis reported African Americans or black individuals experience higher pain intensity across clinical and experimental modalities compared with white individuals **(Meints *et al.,* 2016).**

It has also been suggested patients from the Far East have higher pain tolerance than those from the West .Therefore, orthodontic practitioners should be sensitive towards patients' cultural beliefs, values, pain coping strategies and life experiences when managing pain arising during treatment **(Khalaf and Callister, 1997).**

1.3.4 Anxiety and Fear

Dental anxiety or previous negative dental experiences can increase the risk of reporting pain and psychological factors such as anxiety and dental fear have been found to be associated with more pain during dental procedures **(Bergius et al., 2002; Mobilio *et al.,* 2011)**.

It has been shown that dental anxiety can lower pain threshold and lead to the perception of generally non-painful stimuli as painful and increasing the likelihood of the avoidance of dental treatment **(Pringle *et al.,*2009).**

1.3.5 Stress

Stress can significantly perpetuate the degree of pain; the increase in sympathetic nervous activity occurs in spite of the absence of physical threat. Stress reduces the pain threshold levels, in which the perception of normally painless impulse would be perceived as painful **(Ireland *et al.*, 2017)**

1.3.6 Pain Sensitivity

At any phase of treatment, individual variation can potentially happen in pain processing ranging from the peripheral nociceptor, through pain-regulating mechanisms in the brainstem and spinal cord to the psychological and cognitive processes involved in interpreting and experiencing pain **(Nielsen *et al.,*2009).**

There is no doubt that the physiological and psychological susceptibility of the individuals is considered as a momentous aspect in the intensity of tissue pain caused by the physical effects of appliances. Studies reported that there was no direct relation existed between pain experienced by the patient and the magnitude of forces applied **(Sergl *et al.,* 1998; Bergius *et al.,*2000)**

1.4 Orthodontic Procedures Inducing Pain

1.4 .1 Separator Placement

Placement of orthodontic separators, such as brass wire, elastomerics and spring-type steel separators, is the first step in the fixed orthodontic treatment to create space mesially and distally to teeth for banding. Several researchers have documented that most patients experience pain and concluded that there was discomfort during separator placement which usually initiates within 4 hours of insertion. An increase in the intensity of discomfort occurs over the following 24 hours and within 7 days, it decreases to pre-placement level **(Bondemark *et al.*, 2004**).

1.4.2 Appliance Activation

Appliance activation causes disruption in the periodontal ligament creating areas of pressure and tension leading to discomfort to the patient. An increase in pain 24 h after activation of appliance was observed in their patients **(Trein *et al.*, 2013**)

Ogura *et al.* (2009) compared the pain intensity among subjects with light and heavy force application and found that heavy forces cause greater biting pain few hours after the force application.

Luppanapornlarp *et al.* (2010) evaluated the effect of force levels on the pain intensity and tooth movement and thus concluded that lower forces produced less pain as compared to higher forces with equally effective tooth movement.

1.4.3 Intermaxillary Elastics

Intermaxillary elastics have been found to cause pain in patients similar to wire placement, but the pain due to elastics was not found to last as long as the pain found after initial bonding **(Tuncer *et al*., 2011).**

1.4.4 Fixed Versus Removable Appliance Treatment

fixed appliances produced greater intensity of pain compared to removable appliances**,** possibly due to the application of constant force used in fixed orthodontic appliance compared with intermittent force used with removable appliance **(Diddige *et al.*, 2020)**.

A recent randomized controlled trial (RCT) reported pain of low to moderate levels in both groups, albeit the difficulty with eating being more pronounced in the fixed group **(Wiedel and Bondemark, 2016).**

1.4.5 Orthopaedic Appliances

Rabah *et al*. (2022) have compared the pain and discomfort levels in patients treated with either slow or rapid maxillary expansion (RME) and concluded that RME resulted in higher levels of pain and more chewing difficulties, presumably due to the mechanical forces of increased magnitude. being transmitted and absorbed by the craniofacial complex. Despite this, these difficulties slowly decreased over time as treatment progressed.

Another extraoral orthopaedic appliance, headgear, which is commonly used for extraoral anchorage and traction purposes produces discomfort after 24 hours, after which the pain declines after three days **(Cureton, 1994).**

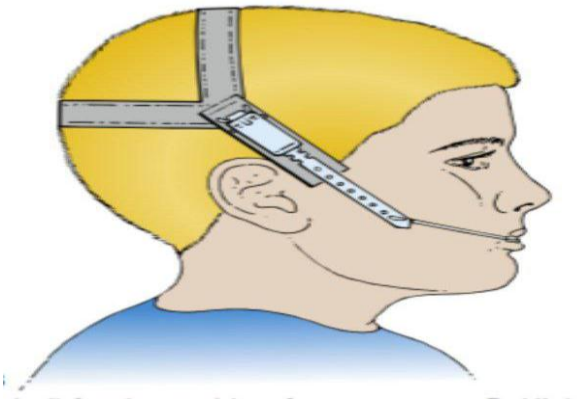

Fig 2 : Headgear (Graber et al, 2017)

1.4.6 Debonding

The action of applying rotational or torqueing forces to remove orthodontic brackets/bands and their residual adhesive from the enamel has been shown to induce pain as forces are transmitted to the teeth. Pain varies according to the teeth being debonded, with upper and lower anterior segments experiencing. greater pain than posterior segments**(Kilinc and Sayar, 2019).**

In terms of bracket types, ceramic brackets removal caused significantly greater pain than either plastic or metal brackets **(Nakada *et al.*, 2021).**

It has been suggested applying finger pressure onto the teeth **(Bavbek *et al.*, 2016),** or asking patient to bite onto a cotton roll could minimise the pain associated with bracket debonding **(Gupta *et al.*, 2022),** presumably due to the stabilising intrusive force.

1.4.7 Insertion of Temporary Anchorage Devices

Chen *et al.* (2011) conducted a study to evaluate the pain experienced by the patients during placement of interdental implants and was compared to the baseline value of discomfort during premolar extractions. They concluded that the placement of interdental implants did not cause pain greater than that during traditional orthodontic treatment.

Fig 3 : Temporary Anchorage Device (Mitchell, 2013).

1.5 Pain Evaluation and Classification System

Burstone (1962) proposed a well-defined classification system for orthodontic pain. It appears to be valid even now and to have stood the test of time. In order to study or evaluate pain, patient interview/questionnaire and ratings with visual analogue scale (VAS), McGill pain questionnaire (MPQ), Verbal Rating Scales (VRS) and algometers can be effectively used**.**

painful response to orthodontic mechanics in two ways : one depends on the relationship of force application with pain and the other according to the time of onset. According to that author, the degree of pain perceived in response to the amount of force application can be divided into three **(Burstone 1962)** :

1. First degree: the patient is not aware of pain unless the orthodontist manipulates the teeth to be moved by the appliance, e.g. using instruments such as a band pusher or force gauge.

2. Second degree: pain or discomfort caused during clenching or heavy biting-usually occurs within the first week of appliance placement. The patient will be able to masticate a normal diet with this type of pain.

3. Third degree: if this type of pain appears, the patient might be unable to masticate food of normal consistency.

Based on the time of onset, the pain was classified pain as follows Burstone (1962) :

1. Immediate, which is associated with sudden placement of heavy forces on the tooth, e.g. hard figure of eight tie between the central incisors to close a midline diastema.

2. Delayed: produced by variety of force values from light to heavy and representing hyperalgesia of the periodontal membrane. This type of pain response decreases with time i.e. the pain reaction might start as third degree but become second or a first degree with the passage of time.

1.6 Studying Pain

It is well-known that correct measurement of pain is an essential part of its evaluation, and adaptation of methods to control it. Various approaches have been used to measure and evaluate pain perception in orthodontic patients. The methods adopted vary from traditional surveys with pre tested questionnaires, rating with MPQ, VRS, VAS and algometers .

A common method used in medical research, but less explored in orthodontics, is the MPQ . This consists of three major classes of word descriptors-sensory, affective, and evaluative that are used by patients to specify subjective pain experience. It also contains an intensity scale and other items to determine the properties of pain experience. The main advantage of the MPQ is the provision to identify quantitative measures of clinical pain. The pain rating index is a short form of MPQ, which can be used in routine clinical practice because of its user-friendly nature **(Melzack, 1975).**

VRS is another method to evaluate orthodontic pain . This consists of a list of adjectives to describe different intensities of pain. The method requires patients to read a list of adjectives and select the word or phrase that best describes their level of pain. An adequate VRS scale should include adjectives that reflect extremes such as 'no pain' and 'excruciating/extremely intense pain **(Jones and Richmond, 1985; Jones and Chan, 1992a, b).**

Simmons (1994) proposed use of an algometer to evaluate pain in patients sitting in dental chair. A data acquisition system was utilized to record the measurement of forces applied to teeth as fixed orthodontic appliances were adjusted. The device contains two input systems one is a metal strip attached to the orthodontic brackets and the other, a 5V signal from a remote control television unit that the patient activates when they begin to feel pain. More research is needed in to this electronic system of pain assessment before clinical application, so that accurate and reliable results other than subjective evaluation from patients can be obtained.

Most of the studies have utilized a VAS, which is designed to present the respondent with a rating scale with minimum constraints. The respondent is expected to mark a location on the line corresponding to the amount of experienced pain. This has been claimed to have two advantages **(Linacre, 1998)** :

1. It provides freedom to choose the exact intensity of pain.

2. It gives maximum opportunity for expression in an individual personal response style.

1.7 Relation between Orthodontic Pain and Patient Compliance and Daily Activities

Orthodontic pain has a clear impact on patients' obedience and daily activities. Functional and aesthetic impairments during wearing of appliance are considered the major reasons affecting patient compliance.Most orthodontic patients change the texture of their food due to the difficulty in chewing and biting solid foods. The discomfort of using orthodontic appliances can be an important factor affecting patients' compliance **(Sergl *et al.*, 1998 ; O'Connor, 2000)**.

Pain, aesthetic and functional impairment caused by appliances are some of the major causes of early termination or discontinuation of treatment. During the 6-months period that follows appliance placement, researchers have found a significant correlation between patients' cooperation and complaints **(Sergl *et al.*, 1998)**.

The initial attitude of the patients towards orthodontics should be understood during the diagnostic phase itself and should be discussed with the patients in all its reality. In psychology, this procedure is termed as 'rational restructuring' will prepare the patients to encounter discomfort during treatment through their own methods and also with the help of a specialist **(Todesco *et al*., 1992**).

Brown and Moerenhout (1991) reported that pain from orthodontic treatment has a definite influence on daily activities of patients. The pain experienced during the first 48 hours is considered to be so disturbing and results in sleepless nights and the use of medication.

Even though the results were statistically insignificant, they reported that approximately 50 per cent of their patients had problems with their daily activities at 6 hours and on days 1 and 2. There was a decrease in the severity of discomfort and the number of patients experiencing it from day 3 onwards **(Erdinç and Dinçer ,2004).**

1.8 Management of Orthodontic Pain

The control of pain during orthodontic treatment is of great interest to clinicians. Although it is not possible to remove pain completely despite the developments in understanding pain mechanism, it should be every orthodontist's objective to minimize pain as much as possible **(Krasny *et al.*, 2013)**.

Many methods have been invented to relieve orthodontic pain in medical practice, including pharmacological approaches, mechanical approaches, Laser irradiation therapy and behavioural approaches . In addition, the use of gene therapy for relieving pain is becoming widely accepted and may hopefully be used for pain relief by orthodontic patients in the future **(Gupta *et al.*, 2014; Wang *et al.*, 2015).**

1.8.1 Pharmacological Approach

Non steroidal anti inflammatory drugs (NSAIDs) are often recommended by orthodontists to their patients to alleviate the pain caused during orthodontic tooth movement. Usually, analgesics are advised after the procedure is performed, but preemptive administration of analgesics has been found to be useful before procedures like separator placement **(Minor *et al.*, 2009).**

Ashkenazi and Levin,(2012) reported in their study that 59% of the patients informed their orthodontist of pain, but only 21% were prescribed analgesics.

Bradley *et al*.(2007) conducted a randomized control trial comparing the efficacy of paracetamol and ibuprofen in relieving pain due to separator placement. They suggested that patients taking ibuprofen reported discomfort on orthodontic separation.

Patel *et al.*(2011) evaluated the effectiveness of ibuprofen, naproxen sodium, and acetaminophen. They concluded that ibuprofen was superior to the placebo in relieving post separator pain as measured by the visual analog scale pain summary scores, whereas acetaminophen and naproxen sodium did not significantly differ from the placebo.

A report suggests that NSAIDs stop tooth movement and also increase the risk of root resorption. Therefore, Paracetamol was considered the safest NSAID as it had no effect on tooth movements as well as root resorption. Also, acetaminophen showed no significant effect on prostaglandin synthesis and may be a safer option than ibuprofen for the relief of pain associated with orthodontics **(Shetty *et al.*, 2013)**.

Arantes *et al.*(2009) evaluated an alternative drug tenoxicam in 36 patients and showed that it proved to be an effective drug during orthodontic treatment without affecting the tooth movement.

Young *et al*.(2006) showed another drug valecoxib to be administered before the procedure to relieve pain due to initial wire placement.

1.8.2 Non-Pharmacological Approach

Some non-pharmacological approaches that have been tested to alleviate pain arising from orthodontic procedures include low level laser therapy (LLLT), chewing gum/bite wafers, cognitive behavioural treatment, vibratory stimulation and Transcutaneous Electrical Nerve Stimulation (TENS) **(Topolski *et al.*, 2018).**

1.8.2.1 Low Level Laser Therapy :

Low-level laser therapy has been widely used for pain alleviation in both medical and dental practice .it had been used as a treatment modality for orthodontic pain control. Besides its analgesic effect, it also enhances tissue recovery and speeds up the tooth movement. It involves the application of laser irradiation to the entire dental arch **(Huang *et al.*, 2015).**

Fujiyama *et al.* (2008) studied the effect of carbon dioxide laser on pain reduction in 60 patients and concluded that local carbon dioxide laser irradiation reduced pain without affecting the orthodontic tooth movement.

A study of 60 patients confirmed that low-level laser therapy reduced pain after initial arch wire placement **(Tortamano *et al.*, 2009).**

Domínguez and Velásquez, (2013) reported reduction in pain symptoms on application of low-level laser therapy after activation of final archwires.

Single-dose, helium-neon laser therapy was found to be effective in reducing orthodontic pain in patients with maxillary canine retractions. The therapy contributed to a 12.1% pain reduction compared to the placebo group. But the study had its own limitations, and no previous studies had investigated the effectiveness of helium-neon laser therapy versus other laser types **(Sobouti *et al.*, 2015).**

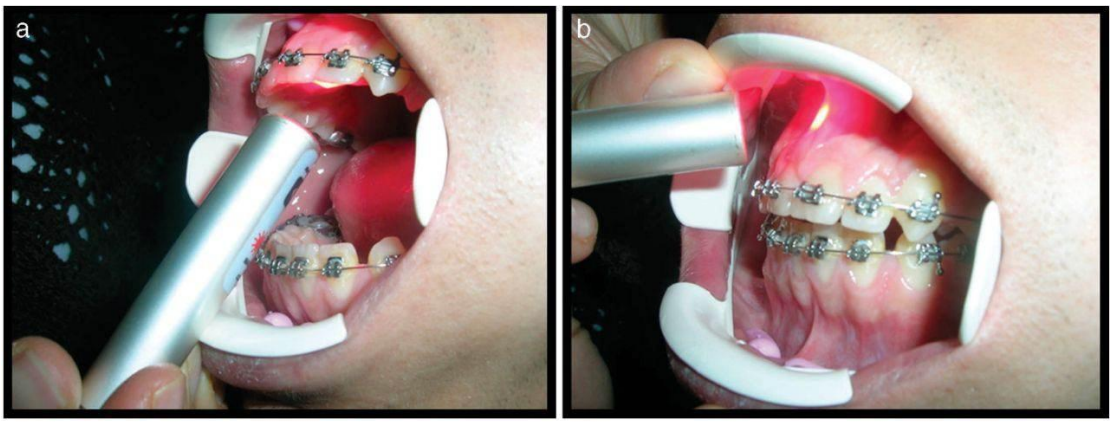

Fig 4 : Application of low-level laser therapy (Ilker Görür et al., 2010)

1.8.2.2 Chewing Gum

Farzanegan *et al.*(2012) conducted a randomized clinical trial on 50 patients to evaluate the efficacy of various measures to reduce pain after placement of initial archwires. They suggested that efficacy of chewing gums as a method to relieve pain caused due to such orthodontic procedures was comparable to that of analgesics.

Benson *et al,* (2012) conducted a randomized clinical trial on 57 patients and reported that the use of chewing gum significantly decreased both the impact and pain from the fixed appliances. Chewing gums can be recommended as a suitable alternative to analgesics for pain reduction in orthodontic patients.

Ireland *et al.* (2016) suggested chewing soft, sugar-free gum to reduce the amount of ibuprofen uptake by patients following initial bond up and first archwire change.

1.8.2.3 Bite Wafers

Mangnall *et al.* (2013) conducted a randomized clinical trial the results of which showed a reduction in pain during debonding procedures when the patients were made to bite on soft acrylic wafers.

Hwang *et al.* (1994) also suggested the use of the bite wafers to relieve pain after orthodontic procedures.

1.8.2.4 Vibratory Stimulation

Marie et al. (2003) have advised the use a vibratory apparatus by the patients to ameliorate the pain caused by orthodontic treatment. Vibratory forces are effective when used before the development of pain as they improve and re-establish the blood supply in the pain-causing ischemic areas. However, once orthodontic pain manifests, the vibratory effect is not effective in ameliorating the pain.

Most patients reported not being able to tolerate the vibratory stimulation once discomfort was present **(Thammanichanon *et al.*, 2020).**

1.8.2.5 Anesthetic Gels

Keim (2004) described an anesthetic gel "oraqix" containing a combination of lidocaine and prilocaine in 1:1 ratio by weight. Such gels can be used when performing routine orthodontic procedures to relieve the patient's discomfort.

Kwong *et al.* (2011) described the use of two anesthetic gels oraqix and TAC alternate for easy placement of temporary anchorage devices and showed that TAC alternate was more effective in reducing the local discomfort.

1.8.2.6 Medicated Wax

Kluemper *et al.* (2002)conducted a comparative study on subjects using wax to relieve the discomfort caused by fixed orthodontic appliances with those using wax containing slow releasing benzocaine. The patients using medicated wax reported of less pain as compared to the other group showing the analgesic properties of benzocaine containing wax.

1.8.2.7 Behavioral Approach

Different behavioral approaches are used to reduce orthodontic pain. They include: physical activity , cognitive behavioral therapy (CBT) and music therapy. Reassurance and attention confusion are the common features shared by these procedures. Anxiety and stress have been reported to accompany orthodontic pain, and a quick follow-up could decrease the levels of orthodontic pain significantly. This means that by reassuring orthodontic patients, orthodontic pain may be controlled **(Xu *et al.*, 2013; Sandhu SS and Sandhu J, 2015).**

Cognitive behavioral therapy (CBT) is a form of psychotherapy uses several treatment sessions to correct the negative attitudes of the patients and reduce their anxiety. Increased anxiety aggravates pain sensations in patients via the limbic system-mediated neural pathways. It has been shown in clinical practice that lowering of patients' anxiety through CBT is an effective way of reducing orthodontic pain **(Bartlett *et al.*, 2005)**.

Music therapy and physical activity, through distracting patients' attention via the insular cortex- mediated neural pathways, have been revealed to alleviate orthodontic pain in clinical practice. However, due to scarce evidence, the efficacy of behavioural therapy in orthodontic pain relief should be further confirmed **(Xu *et al.* 2013).**

1.8.2.8 Transcutaneous Electric Nerve Stimulation [TENS]

Roth and Thrash,(1986) evaluated the effect of TENS in reducing periodontal pain after separator placement. Although it was able to reduce pain within a relatively short span of time of electrode placement, there is dearth of literature published on its use

Fig 5 : Transcutaneous electrical nerve stimulation (Haralambidis, 2019).

1.8.2.9 Gene Therapy

Gene therapy refers to a method of moving DNA sequences or genes to target cells with a view to alter the biological functions of the target cells. When endogenous opioid genes are moved into neurons, the alleviation of pain could be achieved **(Tzabazis *et al.*,2014)**.

In a clinical trial of humans, gene therapy was used to alleviate cancer pain and satisfactory results were obtained. Different types of viral vectors have been employed for conveying concerned genes into target cells, including herpes simplex virus. Neurotropism of herpes simplex virus makes it to be useful in gene therapy for disorders of the nervous system including pain . Furthermore, endogenous opioid genes or RNA interference sequences can be transferred into the trigeminal ganglia against pro-inflammatory genes like Calcitonin gene-related peptide (CGRP) by using herpes simplex virus to alleviate orthodontic pain. Nowadays, in clinical practice, gene therapy usage is restricted due to biosafety reasons. However, gene therapy may become an applicable treatment method for the alleviation of orthodontic pain if its biosafety complicity is looked into in the near future **(Smith, 2012; Grinde, 2013).**

Chapter two : Discussion

Orthodontic pain starts at around after 2 hours of appliance placement, with some studies reporting that this is the case for between 91% and 97% of orthodontic patients It then usually peaks at 24 hours before gradually subsiding over the next 5 to 7 days interestingly, it would seem that up to 25% of orthodontic patients report experiencing pain for longer than 7 days **(Fleming *et al*., 2009).**

The degree of pain experienced by individuals in response to an identical noxious stimulus can vary greatly from person to person. The perception of pain may be influenced by a number of different factors. Anxiety has been shown to be a factor affecting dental pain, and pain reported by adolescents to be greater than in other age groups, two studies have reported pain experience to be greater in girls than in boys whilst others have concluded that gender has no effect on pain perception following the placement of initial arch wires **(Pringle *et al.*, 2009).**

Administering analgesics 2 hours before extraction reduces the post extraction pain because it was found that pain perceived after orthodontic treatment is greater than that of following extraction **(Bernhardt *et al.*, 2001)**

It is important to know that psychological pain associated with orthodontic treatment can be reduced by proper explanation and counseling while the real pain experienced by patients can be reduced by administering analgesics before major orthodontic procedures like separator placement, banding, as well as arch wire placement **(Minor *et al*., 2009)**

Chapter three : Conclusions and Suggestions

3.1 Conclusions

1_ Orthodontic treatment is associated with a number of side effects most common being pain although pain is unavoidable in every stage of orthodontic treatment and is impossible to eliminate it completely, Orthodontists must be aware of the various factors that might cause discomfort to the patients and should be able to manage such episodes to improve the compliance of patients with the orthodontic therapy.

2_ Effective communication between the orthodontist and the patient and somewhat focused dietary advice may help avoid pain and suffering.

3_ Analgesics are still considered the best choice for subsiding painful sensation associated with orthodontic treatments. Ibuprofen and acetaminophen provide a consistent analgesic effect.

3.2. Suggestions for further studies

1_ Further study is required to know more about the importance of transcutaneous electrical nerve stimulation to control pain associated with orthodontic treatment.

2_ It is suggested that there will be more studies in the future on the importance of acupuncture in relieving orthodontic pain, because the mechanism of this method is currently unknown to a large extent.

3_ I suggest there are other important ways to relieve orthodontic pain, including using an ice pack on the area that feels uncomfortable and can soothe it, and also the importance of gargling with warm salty water, which can help heal any sores or wounds caused by braces. . this suggetions need to conduct more studies to find other ways to relieve orthodontic pain in the future.

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