



Orthodontic pain- A review

Dr. Aier Kipenzula Esther¹, Dr. Kothari Bhavesh², Dr. Garg Kamlesh³

¹ Department of Orthodontics and Dentofacial Orthopaedics, Pacific Dental College and Hospital, Udaipur, Rajasthan, India

² Professor, Head, Department of Orthodontics and Dentofacial Orthopaedics, Pacific Dental College and Hospital, Udaipur, Rajasthan, India

³ Professor, Department of Orthodontics and Dentofacial Orthopaedics, Pacific Dental College and Hospital, Udaipur, Rajasthan, India

Abstract

Orthodontic pain is a prevalent concern during treatment, primarily resulting from the application of mechanical forces that induce inflammatory responses in periodontal tissues. This discomfort typically peaks within 24 hours of appliance activation and gradually subsides over the subsequent days. Effective pain management is crucial to ensure patient compliance and comfort throughout the orthodontic process.

Pharmacological interventions such as Nonsteroidal anti-inflammatory drugs (NSAIDs), ibuprofen and naproxen remain the cornerstone of orthodontic pain management, due to their efficacy in reducing inflammation and alleviating pain. Non-pharmacological approaches such as low-level laser therapy (LLLT), transcutaneous electrical nerve stimulation (TENS), vibratory stimulation, and cognitive behavioral therapy have shown varying degrees of success in pain reduction.

Keywords: Orthodontic pain, Inflammation, NSAID'S, Quality of Life

Introduction

Orthodontic pain is a prevalent and significant concern during treatment, particularly among adolescents. Studies indicate that between 87% and 95% of adolescents experience pain during fixed orthodontic treatment, especially within the first 24 hours.^[1] Moreover, 39–49% report pain during every step of the treatment or after appliance removal.

This discomfort typically arises from the application of orthodontic forces, leading to inflammatory responses in periodontal tissues. Pain often begins within four hours of appliance activation, peaks around 24 hours, and gradually diminishes over the subsequent days. However, more than 40% of adolescent patients report orthodontic pain persisting beyond one week, indicating the potential for prolonged discomfort.

The impact of orthodontic pain extends beyond physical discomfort, significantly affecting patients' quality of life. A study by Banerjee *et al.* (2018)^[2] found that the Oral Health-Related Quality of Life (OHRQOL) scores increased significantly (mean 43.5 ± 10.9) in the initial phase of treatment, with 95% of patients reporting pain or discomfort.^[2] After one day of appliance placement, over 85% experienced severe to mild pain, and 9% suffered very severe pain.

Effective pain management is crucial for ensuring patient compliance and comfort during orthodontic therapy. Pharmacological interventions, such as non-steroidal anti-inflammatory drugs (NSAIDs) like ibuprofen and acetaminophen, have demonstrated efficacy in alleviating orthodontic pain. However, concerns regarding potential side effects have prompted the exploration of non-pharmacological alternatives. Physical interventions, including low-level laser therapy (LLLT), vibratory

stimulation, acupuncture, and chewing exercises, have shown promise in reducing pain intensity.

Orthodontic pain is a common and impactful aspect of treatment that necessitates a multifaceted management approach. Combining pharmacological and non-pharmacological strategies, tailored to individual patient needs, can enhance treatment adherence and overall satisfaction.

Mechanism of Orthodontic Pain

Orthodontic pain arises as a biological response to the application of mechanical forces during treatment, initiating a complex cascade involving both peripheral and central nervous systems. Understanding this mechanism is crucial for developing effective pain management strategies during orthodontic treatment, aiming to alleviate discomfort and improve patient compliance.

The mechanisms involved are:

Initiation^[3]: The initiation of orthodontic pain begins when mechanical forces from braces or aligners are applied to teeth, leading to a series of biological responses in the periodontal ligament (PDL).

- Mechanical Compression and Vascular Changes:** The applied orthodontic force compresses the PDL, causing vascular occlusion and reduced blood flow. This hypoxic condition triggers an inflammatory response.
- Inflammatory Mediator Release:** In response to tissue stress and hypoxia, cells within the PDL release pro-inflammatory mediators such as prostaglandins, bradykinin, and substance P. These substances sensitize nociceptors (pain receptors) in the area.

3. **Activation of Sensory Nerves:** The sensitized nociceptors transmit pain signals through the trigeminal nerve pathway to the brain, resulting in the perception of pain.

This process explains the onset of discomfort or pain typically experienced within hours after the application of orthodontic appliances.

Neural Transmission ^[3]: Neural transmission of orthodontic pain involves a complex pathway that begins with mechanical stimulation from orthodontic appliances and culminates in the perception of pain in the brain.

1. **Activation of Periodontal Nociceptors** ^[4]: When orthodontic force is applied to teeth, it causes deformation of the periodontal ligament (PDL), leading to the release of inflammatory mediators. These mediators sensitize nociceptors—specialized sensory nerve endings—in the PDL.
2. **Signal Transmission via Trigeminal Nerve:** The activated nociceptors generate electrical impulses that travel along the primary afferent neurons, primarily the myelinated A δ fibers and unmyelinated C fibers. These fibers are part of the trigeminal nerve system and convey the pain signals to the trigeminal ganglion.
3. **Processing in the Trigeminal Spinal Nucleus:** From the trigeminal ganglion, the signals are relayed to the trigeminal spinal nucleus in the brainstem, particularly the subnucleus caudalis. Here, the signals are modulated and integrated with other sensory information.
4. **Projection to Higher Brain Centers:** The processed signals are then transmitted to higher brain centers, including the thalamus and the primary somatosensory cortex. These areas are responsible for the conscious perception of pain, allowing the individual to localize and interpret the discomfort associated with orthodontic treatment.

Central Processing ^[3]: Brain regions such as the insular cortex, amygdala, hippocampus, locus coeruleus, and hypothalamus are involved in the emotional and cognitive aspects of pain perception. These areas process the affective components of pain, including anxiety and memory.

Central processing of orthodontic pain involves multiple brain regions that interpret and modulate the sensory, emotional, and cognitive aspects of pain. The different regions include:

1. **Insular Cortex**

The insular cortex integrates sensory input with emotional and cognitive information, contributing to the subjective experience of pain. It is involved in interoceptive awareness, allowing individuals to perceive internal bodily states, including pain intensity and discomfort.

2. **Amygdala**

The amygdala plays a crucial role in the emotional processing of pain, particularly in associating pain with fear and anxiety. It helps form emotional memories

related to painful experiences, which can influence future pain perception.

3. **Hippocampus**

The hippocampus is essential for memory formation and has been implicated in the emotional aspects of pain. Studies suggest that orthodontic pain can lead to changes in hippocampal structure, contributing to anxiety-like behaviors.

4. **Locus Coeruleus**

This brainstem nucleus is involved in physiological responses to stress and pain. It modulates arousal and vigilance through the release of norepinephrine, influencing how pain is perceived and responded to.

5. **Hypothalamus**

The hypothalamus regulates autonomic and endocrine responses to pain. It interacts with the limbic system to coordinate the body's reaction to stressors, including the release of stress hormones that can affect pain sensitivity.

Pain Modulation ^[3]: Pain modulation refers to the body's intrinsic mechanisms for regulating and suppressing pain signals, primarily through descending neural pathways. Key structures involved in this process include the periaqueductal gray (PAG) and the dorsal raphe nucleus (DRN).

The PAG serves as a central hub for initiating descending pain inhibition. Upon activation, the PAG stimulates the nucleus raphe magnus (NRM), which then projects to the dorsal horn of the spinal cord. This pathway modulates pain by inhibiting the transmission of nociceptive signals at the spinal level.

The DRN, situated in the brainstem, is rich in serotonergic neurons and plays a pivotal role in pain modulation. Activation of the DRN leads to the release of serotonin, which can inhibit pain transmission in the spinal cord. This serotonergic pathway contributes to the suppression of pain signals, enhancing analgesia. ^[5]

Grading of Pain

There is no way to tell how much pain a person has. No test can measure the intensity of pain, no imaging device can show pain, and no instrument can locate pain precisely. It is thought that the severity or intensity of an individual's pain is the primary factor that determines the impact of the pain on the person's overall functioning and sense of wellbeing. Thus, pain intensity serves as a benchmark for comparison of pathologic conditions over time and is important for determining the effectiveness of intervention strategies.

Pain scales are one of three categories:

1. **Numerical rating scales (NRS):** Uses numbers to rate pain

In a Numerical Rating Scale (NRS), patients are asked to circle the number between 0 and 10, 0 and 20 or 0 and 100 that fits best to their pain intensity. Zero usually represents no pain at all, whereas the upper limit represents the worst pain ever possible. ^[6] (Fig 1)

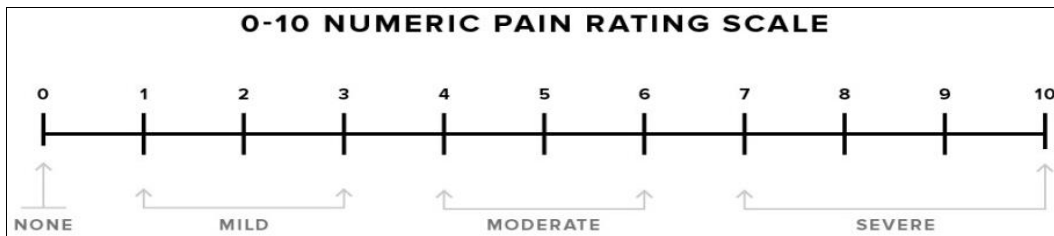


Fig 1: Numerical rating scales (NRS) for pain

2. **Visual analog scales (VAS):** Asks you to select a picture that best matches your pain level. The Visual Analogue Scale (VAS) consists of a straight line with the endpoints defining extreme limits such as ‘no pain

at all’ and ‘pain as bad as it could be’. The patient is asked to mark his pain level on the line between the two endpoints.^[7] (Fig 2)

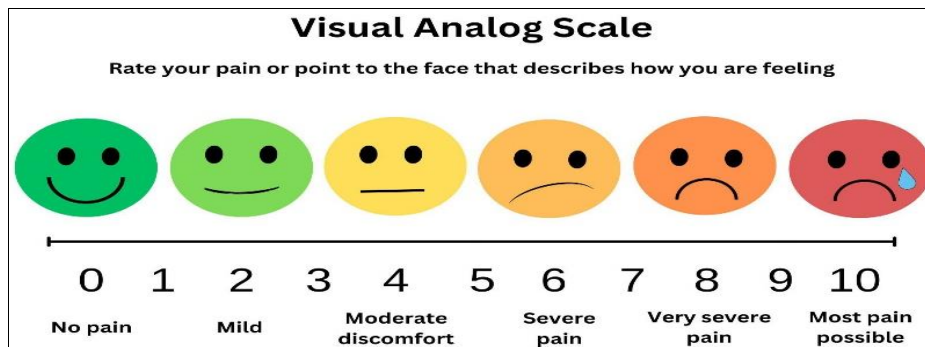


Fig 2: Wong Baker’s Visual Analog Scale

3. **Categorical scales:** Primarily uses words, possibly along with numbers, colours, or locations on the body. (Fig 3) Using a standardized, validated pain scale

increases the reliability and validity of pain assessment in orthodontics.

McGill Pain Questionnaire

Patient's Name: _____ Date Accomplished: _____

Clinician's name: _____

Instructions: Please select which words describe your pain by ticking the buttons for each subcategory.

1. FLICKERING (1) <input type="radio"/> QUIVERING (2) <input type="radio"/> PULSING (3) <input type="radio"/> THROBBING (4) <input type="radio"/> BEATING (5) <input type="radio"/> POUNDING (6) <input type="radio"/> 2. JUMPING (1) <input type="radio"/> FLASHING (2) <input type="radio"/> SHOOTING (3) <input type="radio"/> 3. PRICKING (1) <input type="radio"/> BORING (2) <input type="radio"/> DRILLING (3) <input type="radio"/> STABBING (4) <input type="radio"/> LANCINATING (5) <input type="radio"/> 4. SHARP (1) <input type="radio"/> CUTTING (2) <input type="radio"/> LACERATING (3) <input type="radio"/> 5. PINCHING (1) <input type="radio"/> PRESSING (2) <input type="radio"/> GNAWING (3) <input type="radio"/> CRAMPING (4) <input type="radio"/> CRUSHING (5) <input type="radio"/> 6. TUGGING (1) <input type="radio"/> PULLING (2) <input type="radio"/> WRENCHING (3) <input type="radio"/> 7. HOT (1) <input type="radio"/> BURNING (2) <input type="radio"/> SCALDING (3) <input type="radio"/> SEARING (4) <input type="radio"/> 8. TINGLING (1) <input type="radio"/> ITCHY (2) <input type="radio"/> SMARTING (3) <input type="radio"/> STINGING (4) <input type="radio"/> 9. DULL (1) <input type="radio"/> SORE (2) <input type="radio"/> HURTING (3) <input type="radio"/> ACHING (4) <input type="radio"/> HEAVY (5) <input type="radio"/> 10. TENDER (1) <input type="radio"/>	TAUT (2) <input type="radio"/> RASPING (3) <input type="radio"/> SPLITTING (4) <input type="radio"/> 11. TIRING (1) <input type="radio"/> EXHAUSTING (2) <input type="radio"/> 12. SICKENING (1) <input type="radio"/> SUFFOCATING (2) <input type="radio"/> 13. FEARFUL (1) <input type="radio"/> FRIGHTFUL (2) <input type="radio"/> TERRIFYING (3) <input type="radio"/> 14. PUNISHING (1) <input type="radio"/> GRUELING (2) <input type="radio"/> CRUEL (3) <input type="radio"/> VICIOUS (4) <input type="radio"/> KILLING (5) <input type="radio"/> 15. WRETCHED (1) <input type="radio"/> BLINDING (2) <input type="radio"/> 16. ANNOYING (1) <input type="radio"/> TROUBLESOME (2) <input type="radio"/> MISERABLE (3) <input type="radio"/> INTENSE (4) <input type="radio"/> UNBEARABLE (5) <input type="radio"/> 17. SPREADING (1) <input type="radio"/> RADIATING (2) <input type="radio"/> PENETRATING (3) <input type="radio"/> PIERCING (4) <input type="radio"/> 18. TIGHT (1) <input type="radio"/> NUMB (2) <input type="radio"/> DRAWING (3) <input type="radio"/> SQUEEZING (4) <input type="radio"/> TEARING (5) <input type="radio"/> 19. COOL (1) <input type="radio"/> COLD (2) <input type="radio"/> FREEZING (3) <input type="radio"/> 20. NAGGING (1) <input type="radio"/> NAUSEATING (2) <input type="radio"/> AGONIZING (3) <input type="radio"/> DREADFUL (4) <input type="radio"/> TORTURING (5) <input type="radio"/>	Sensory Score (Items 1-10): _____ Affective Score (Items 11-15): _____ Evaluative Score (Item 16): _____ Total Score (Pain Rating Index): _____ Present Pain Intensity (PPI): _____ PPI: 0 NO PAIN <input type="checkbox"/> 1 MILD <input type="checkbox"/> 2 DISCOMFORTING <input type="checkbox"/> 3 DISTRESSING <input type="checkbox"/> 4 HORRIBLE <input type="checkbox"/> 5 EXCRUCIATING <input type="checkbox"/> BRIEF <input type="checkbox"/> RHYTHMIC <input type="checkbox"/> CONTINUOUS <input type="checkbox"/> MOMENTARY <input type="checkbox"/> PERIODIC <input type="checkbox"/> STEADY <input type="checkbox"/> TRANSIENT <input type="checkbox"/> INTERMITTENT <input type="checkbox"/> CONSTANT <input type="checkbox"/> <div style="text-align: center;"> <input type="radio"/> E = EXTERNAL <input type="radio"/> I = INTERNAL CIRCLE THE BODY PART BEING TREATED TODAY </div> COMMENTS: <div style="border: 1px solid black; height: 50px; width: 100%;"></div>
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Fig 3: McGill Pain Questionnaire

Orthodontic Procedures Inducing Pain

Orthodontic forces depend on the properties of the appliances' materials (elasticity of wires/rubber rings, etc.), the construction particularities, and its interrelation with the dento-maxillary system. The essential coordinates in orthodontic biomechanics are the orthodontic force, the weight-bearing area, and the application area.

Davidovich and Shanfeld have reported that the application of force leads to acute inflammation, which, in turn, results in periodontal vasodilation and the sensation of pain. It is known that the development of hyperalgesic resistance is associated with the release of various chemical mediators.^[8] Types of Orthodontic Procedures That Commonly Induce Pain

1. Separator Placement

Separators are inserted during orthodontic treatment to open interdental contacts and facilitate the placement of molar bands that anchor the arch wires. It is well-known that placement of orthodontic separators (brass wire, elastomerics, spring type steel separators, and latex elastics) results in a painful experience for almost all patients.

Bergius *et al.*, reported that the intensity of pain reached the highest levels the day after placement of separators and gradually reduced after 1 week^[1]. The intensity of the pain can vary from patient to patient and may be influenced by several factors, including the type of separator used, the technique of placement, and individual pain perception.

2. Archwire placement and activation

The pain that develops following the initial placement of an arch wire has been the subject of numerous studies. These studies generally report that most patients begin to experience pain four hours after the application of the arch, with the level of pain reaching its peak within the first 24 hours, and then gradually decreasing.

The type of archwire can influence pain perception. For instance, a randomized controlled trial comparing thermoelastic (heat-activated) and superelastic nickel-titanium archwires found that patients with thermoelastic wires reported significantly lower pain levels on days 2, 3, and 4 post-insertion.^[9]

Pain intensity can vary between different areas of the mouth. Patients often report greater discomfort in the anterior teeth compared to the posterior, especially during the initial stages of treatment.^[10]

3. Orthopaedic Forces and Skeletal Anchorage Systems

Craniofacial orthopaedics utilizes mechanical forces of a high magnitude, which when applied are absorbed and transmitted to the craniofacial complex. These forces will produce a series of reactions characterized by tissue displacement, deformation, and development of internal stress.^[11]

Skeletal anchorage systems, including miniscrews and miniplates, provide stable anchorage for complex tooth movements without relying on patient compliance. The insertion of these devices can cause varying levels of pain. For instance, a study evaluating pain after miniscrew insertion found that the highest pain levels occurred one-hour post-insertion, with significant reduction over the following week. The pain was not significantly influenced

by the length of the miniscrew, the jaw of insertion, or the side of placement.^[12]

Similarly, patients receiving mid-palatal temporary skeletal anchorage devices reported mild to moderate discomfort, primarily related to palatal pain and irritation during treatment. Despite these sensations, the majority of patients found the discomfort manageable, and the devices were well-tolerated.^[13]

4. Debonding

Pain may arise during the active phases of orthodontic treatment and during the debonding procedure. Studies have shown that this discomfort can vary based on several factors, including the method of debonding, the type of brackets used, and individual patient characteristics.

Williams and Bishara (1992) evaluated the threshold level for patient discomfort at debonding and concluded that tooth mobility and force application were the two important influencing factors. They found intrusive forces to produce less pain at debonding in comparison with forces applied in a mesial, distal, facial, lingual, or extrusive direction. They suggested applying finger pressure or asking the patient to bite on a piece of cotton roll to minimize pain while debonding.^[14]

A study evaluating pain perception during orthodontic debonding found that female subjects reported higher pain levels than male subjects, and higher pain scores were recorded for the mandibular anterior teeth compared to the maxillary teeth.^[14]

Furthermore, research comparing different bracket materials revealed that ceramic brackets, despite requiring less removal force, were associated with higher pain levels during debonding compared to metal and plastic brackets. This increased discomfort was attributed to the brittleness of ceramic brackets, which can cause sudden impacts during removal.^[16]

Management

Management strategies include both pharmacological methods, like analgesics, and non-pharmacological approaches, such as low-level laser therapy and behavioral modifications. The discomfort can significantly impact patients' quality of life, leading to challenges in oral hygiene, speech, eating, taste perception, and may cause tooth mobility, halitosis, and gingival bleeding.

1. Pharmacological Management

- **Opioids:** Sometimes known as narcotics, encompass drugs like codeine sulphate, tramadol, and morphine sulphate. They can be categorized as agonistic, agonist-antagonistic, or partial agonist based on their specific method of action, primarily targeting large A- δ fibers in the spinal cord's dorsal horn. These drugs latch onto opiate receptors linked with G-proteins on inhibitory fibers, halting stimuli to the "pain gate" and thus blocking pain signals to the brain^[17].

- **Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)**

Most commonly prescribed drugs to alleviate the pain caused during initial stages of orthodontic treatment. Usually, NSAIDs are advised after the procedure, but pre-operative administration of analgesics 1-2 hour before procedures like separator placement has been found to be more efficacious^[18].

Prostaglandins are responsible for causing pain; inhibition of COX suppresses prostaglandin production and so reduces pain. However, prostaglandins, including PGE1 and PGE2, are important mediators of bone resorption, and it has been suggested that suppression of their activity with NSAIDs may affect the rate of orthodontic tooth movement [17].

- **Acetaminophen or Paracetamol** has been available as an analgesic on prescription and over-the-counter since 1963. The primary mechanism of action of paracetamol is similar to that of NSAIDs. It is believed to inhibit COX, with a predominant effect on COX-2; however, unlike NSAIDs, it is thought to act at a central nervous system level rather than acting across cell membranes. [19].

2. Non-Pharmacological Management

In the last decade, there are several newer methods employing the use of technology that have come up and are being used for alleviating pain. Many of these methods are currently being researched to understand their precise benefits as well as effectiveness in managing pain.

▪ Low-Level Laser Therapy (LLT)

A laser is a device that generates light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.

LLLT is the application of light (usually a low powered laser or LED typically power range of (10mW–500mW). Light with a wavelength in the red to near infrared region of the spectrum (660nm–905nm), is generally employed because these wavelengths have the ability to penetrate skin, and soft/hard tissues and are proven in clinical trials to have good effect on pain, inflammation and tissue repair [20].

The power density (irradiance) is usually between 5W/cm² and is applied to an injury or to a painful site for 30–60 seconds a few times a week for several weeks. The result is a reduction of inflammation, pain relief and accelerated tissue regeneration. In most cases the lasers/LEDs used for LLLT emit a divergent beam (not focused or collimated) because collimation is lost in tissue, but as a consequence ocular risks are also diminished over distance. [21]

It has been seen that low-level laser therapy induces cellular proliferation which results in differentiation of osteoblasts bringing about bone formation. Low-energy lasers have also been found to help enhance orthodontic tooth movement, but more research is still being conducted on the same.

▪ Light Emitting Diodes (LEDs)

Photo-biomodulation has become popular in recent years, and it involves the use of light-emitting diodes to enhance healing, control inflammation, and reduce pain and discomfort across different scenarios. [22]

LEDs (in the range of 670 nm) have been shown to be highly beneficial in cancer patients for the management of oral mucositis, but the near infra-red region light (in the range of 850 nm) has been shown to help in release of growth factors and vasodilation, thereby helping promote wound healing. [23]

▪ Micropulse Variations

The rationale behind the use of vibration devices is the application of the gate control theory according to which pain reduction can be achieved by simultaneously activating nerve fibres with non-noxious stimuli. Previous studies by

Wendy D. Lobre *et al.* and Fatih Celebi have shown that vibration decreases the pain originating from the dento-alveolar complex [24, 25]

▪ Transcutaneous Electrical Nerve Stimulation (TENS)

Transcutaneous electrical nerve stimulation, known by its acronym TENS, is a modality that uses electric current to activate nerves for therapeutic reasons. The TENS unit is a small device, often battery-operated, which can sometimes even fit into a pocket. It utilizes electrodes placed on the skin and which connect to the unit via wires to address a targeted therapeutic goal. [26]

During TENS Electrical stimulation activates non-painful sensory fibres (A β fibres), which inhibit the transmission of pain signals by nociceptive fibres (A δ and C fibres) at the spinal cord level. TENS promotes the release of natural pain-relieving chemicals like endorphins and enkephalin, which act on opioid receptors to reduce pain perception. Patients can self-administer TENS and titrate dosage as required because there is no potential for overdose and there are few side effects or drug interactions.

A study demonstrated that patients receiving TENS therapy after orthodontic adjustments reported significantly lower pain levels at 24, 36, and 48 hours compared to control groups. [27]

▪ Low-Intensity Pulsed Ultrasound (LIPUS)

LIPUS is a non-invasive modality that utilizes acoustic pressure waves with frequencies higher than the human threshold. This method is widely utilized in the field of medicine for diagnosis as well as therapeutic purposes.

In orthodontics, LIPUS has been explored for its potential to accelerate tooth movement and alleviate treatment-associated pain. [28]

LIPUS operates on the principle of mechanotransduction, where mechanical stimuli are converted into biochemical signals. When applied to periodontal tissues, LIPUS induces micromechanical stress, leading to increased cellular permeability, enhanced blood flow, and the stimulation of osteogenic and cementoblastic activities. This process facilitates bone remodeling and may contribute to the repair of orthodontically induced root resorption.

A randomized controlled trial assessed the impact of LIPUS on pain during orthodontic separation. The study found that patients receiving LIPUS therapy reported significantly lower pain levels at 24 hours, 4 days, and 5 days post-separation compared to the control group. The authors concluded that LIPUS is a safe and effective method for controlling orthodontic pain. [29]

▪ Virtual Reality

This is the latest example of technology being used to create a realistic appearing simulation. Sensory illusions can be framed to promote behavioural changes in an environment that can be augmented using digital information.

Commonly used devices for sensory stimulation are helmets, headphones, and actuators with sensors that can change the simulation depending on the patient response. The major benefit of virtual reality over the other methods is that patients would feel a psychological presence in the simulated environments because of the sensory immersion. Augmented reality can help alleviate pain by distracting the patient 's attention away from pain due to orthodontic treatment [30].

3. Other Less Explored Methods

- **Music:** It has various positive effects on the human brain, and helps to soothe and relax. In addition, music therapy was found to be an effective non-pharmacological approach for postoperative pain management ^[31].

Binaural beat is a sound with a steady intensity and frequency presented to one ear and another sound with the same intensity but slightly different frequency presented to the other ear. The brain then produces pulsations in the amplitude and localization that is the same with the perceived sounds.

Binaural beats can change the frequency towards a desired state, by synchronizing its own electric cycles to the same rhythm, whether favouring relaxation or alertness ^[32].

Preliminary evidence suggests that brainwave entrainment is effective in several cognitive domains and can relieve acute and long-term stress, reduce pain, headaches, migraines and operative anxiety; and improve behavior, mind wandering and creativity ^[33].

- **Attitude Modification Interventions:** includes cognitive behavioural therapy, structured phone calls, and text messages are effective methods to control pain in patients undergoing orthodontic treatment ^[34].

Conclusion

Orthodontic pain is a prevalent and significant concern during treatment, particularly in the initial stages. Effective pain management strategies are crucial for enhancing patient compliance and satisfaction. Additionally, patient education and counseling play a vital role in pain perception and tolerance. Providing comprehensive information about the treatment process and setting realistic expectations can significantly reduce anxiety and improve the overall treatment experience. By addressing both the physical and psychological aspects of orthodontic pain, clinicians can ensure a more comfortable and successful treatment journey for their patients.

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