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Orthodontic Pain- Blessing with Disguise

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Abstract: *Orthodontics is based on tooth movement through bone resulting from the application of mechanical forces. The bone remodeling takes place through an inflammatory process associated with pain or discomfort. Orthodontic pain is the most frequent complaint of the patients undergoing orthodontic therapy. The lengthy duration of treatment along with frequent pain due to the orthodontic appliances often leads to patient burn out and has been associated with discontinuation of orthodontic treatment. The purpose of this review article is to throw a light on the various possible causes of orthodontic pain and to discuss the various management options for the orthodontic pain.*

Keywords: *Orthodontic Pain, Nonsteroidal-antiinflammatory drugs, orthodontic tooth movement.*

I. Introduction

Dental therapy in general, including orthodontic treatment, usually causes pain or distress. Pain is considered a very subjective symptom, for this reason, it is best defined as: "An uncomfortable sensory and emotional experience associated with real or potential injuries or described in terms of such injuries"[1].Individual's past experiences, emotional state, cultural background, age and sex[2,3]are among the facts that influence pain level, all of which may pose difficulties in measuring symptoms.

Surveys of orthodontic patients have revealed that pain is among the most cited negative effect of orthodontic therapy[4] and even when compared with the pain of invasive procedures such as extractions, patients perceived orthodontic pain to be greater in both incidence and severity[5].

The pain is generated by the orthodontic movement which is a complex biomechanical process induced by prolonged application of mechanical forces, creating pressure and tension zones in the periodontal ligament and alveolar bone [6]. Bone is deposited on the alveolar wall in the tension zone and resorbed by osteoclasts in Howship's lacunae in the pressure zone[7].

Remodeling occurs in dental and paradental tissues, including dental pulp, periodontal ligament, alveolar bone and gingiva. These tissues, when exposed to mechanical loading, express significant macroscopic and microscopic changes. At cellular level, orthodontic tooth movement is characterized by initial acute inflammation, followed by a chronic inflammatory process[9].For the patient, the periods of acute inflammation are associated with painful sensations and reduced activity. It has been reported that the peak of pain occurs the day after the adjustment, with a decrease over the next 6 to 8 days [5,10-13].

A study which was done in India revealed that 8 per cent of a study population discontinued the orthodontic treatment because of pain.[8,]

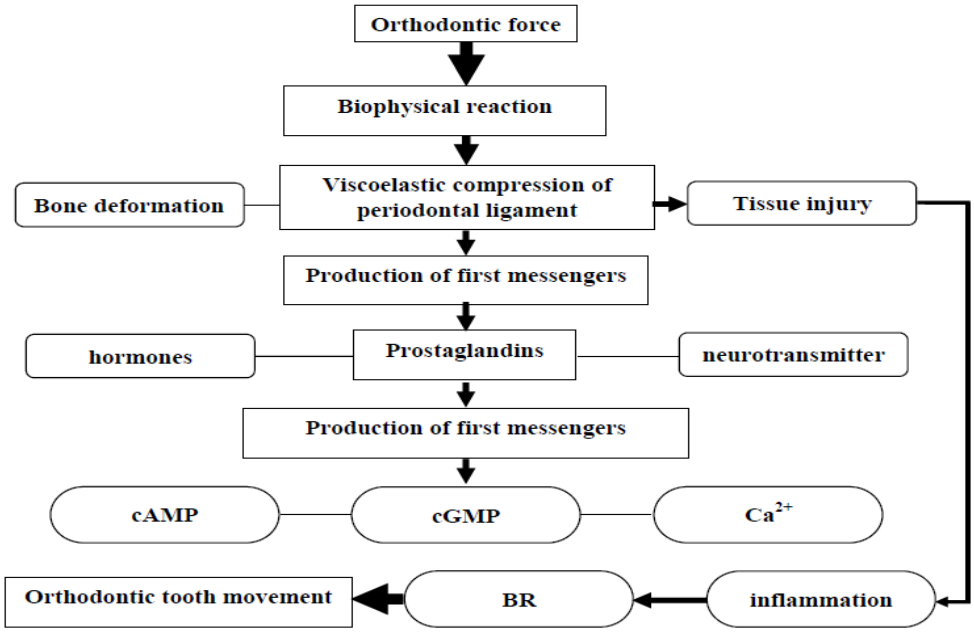
A number of studies reveal that the initial and delayed pain response following orthodontic force application is caused by the hyperalgesia of the periodontal ligament. The hyperalgesia makes the periodontal ligament sensitive to the high levels of the released algogens such as histamine, bradykinin, prostaglandins, and serotonin[14]. Ninety to ninety-five percent of orthodontic patients report experiencing this discomfort [15].The most common group of medications used in orthodontics for pain relief consists of nonsteroidal anti-inflammatory drugs (NSAIDs)[14,16], other methods are low-level laser therapy, Transcutaneous Electrical Nerve Stimulation (TENS),anaestheticgels, bite wafersand vibratory stimulation of the periodontal ligament. All these methods have been successful to a certain degree, however, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) has emerged as the most preferred method[8,16].

The visual analogue scale (VAS), McGill pain questionnaire (MPQ), Verbal Rating Scales (VRS) and algometers have been used to assess the pain experienced by patients. The VAS, particularly the graded and linear horizontal scale, has been shown to be the most reliable and accurate tool in the evaluation of subjective experiences such as pain[17].

Biochemical reactions in orthodontic tooth movement[18]

In the relation between pain and rate of orthodontic movement an important link seems to be prostaglandins (determined by mechanical deformation of the periodontal ligament as a result of orthodontic

force). Prostaglandins are synthetize from arachidonic acid by the cyclooxygenases (COX). The two types of COX, COX-1 and COX-2, have different roles. While COX-1 has physiological functions such as vascular hemostasis and maintenance of the normal gastric mucosa, COX-2 is being regulated by inflammatory mediators and generates prostaglandins that have a role in pathophysiological and inflammatory processes including pain.



cAMP = adenosine 3', 5' monophosphate (cyclic AMP); cGMP = guanosine 3', 5'- monophosphate (cyclic GMP);
BR = bone remodeling.

CAUSES OF ORTHODONTIC PAIN

Initial stages of treatment

Pain experience has been a common problem faced by patients right from the beginning of orthodontic treatment that is, placement of separators. Asiryet al. conducted a study to evaluate the effect of elastomeric separators on pain experienced by patients and concluded that pain associated with orthodontic separation starts and peaks within 4–48 h from the placement of separators and starts to decline to reach the lowest level on 5th day[19].Most of the orthodontic patients routinely report pain, due to alterations in the periodontal ligament and surrounding soft tissues, with intensity and prevalence varying according to age. According to Campos et al. both children and adults complain of pain after bonding and initial wire placement[20].

Jones reported that pain is experienced by the majority of patients 4 hours after arch wire placement, which will peak at 24 hours and then decline[11]. Jones and Chan stated that pain from arch wire placement can be worse in some patients and could even be more than that experienced after tooth extraction[5]. Comparing various arch wires to determine differences in pain perception showed statistically non-significant results[16,21,22].

Cioffiet al. found reduced pain response in their patients during initial wire placement when they used heat activated thermal nickel-titanium (Niti) as compared to superelastic Niti[23].

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 by Treinet al. in their patients[24].

Luppanapornlarpet al. 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[25].Ogura et al. 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[26].

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[27].

Debonding of orthodontic appliances

Mangnallet al. conducted a multicenter trial and suggested that debonding of fixed appliances leads to pain experience in the patients. Furthermore, lower anteriors were reported to be most painful after debonding[28]. Normandoet al. compared two methods of debonding that is, a lift-off method and ligature cutting pliers and confirmed that lift-off method caused lesser pain to the patients during debonding[29].

Insertion of temporary anchorage devices

The study was conducted by Chen et al. 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[30].

Pain evaluation system

well-definedclassification system for orthodontic pain proposed by Burstone (1962)[31] . 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 VAS, McGill pain questionnaire (MPQ), Verbal Rating Scales (VRS) and algometers can be effectively used.

Classifying pain

Burstone (1962) classified a 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:

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 time of onset, Burstone (1962) further classified pain as follows:

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 hyperalgaesia 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 fi rst degree with the passage of time.

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 pretested questionnaires, rating with VAS [32], MPQ [33], VRS [5], and algometers[34]. Most of the studies have utilized a VAS, which is designed to present the respondent with a rating scale with minimum constraints [32]. 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:

1. It provides freedom to choose the exact intensity of pain.
2. It gives maximum opportunity for expression in an individual personal response style.

Another common method used in medical research, but less explored in orthodontics, is the MPQ[33](Melzack, 1975). 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.

VRS is another method to evaluate orthodontic pain[5](Jones and Richmond, 1985 ; Jones and Chan, 1992a , b). 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 ’.

Simmons (1994) proposed use of an algometer to evaluate pain in patients sitting in dental chair[34]. A data acquisition system was utilized to record the measurement of forces applied to teeth as fi xed 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.

Management Of Orthodontic Pain

The existing literature supports the use of non-steroidal anti-inflammatory drugs (NSAIDs) for pain control, even though other methods (such as anaesthetic gel, bite wafers, transcutaneous electrical nerve stimulation, low level laser use and vibratory stimulation) have been suggested. The major concern regarding NSAIDs is the interference produced on inflammation associated with tooth movement process. Low doses administered for one or two days in the initial stages will not affect the tooth movement process as such.

Analgesics

Nonsteroidalantiinflammatory 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[35].

Ashkenazi and Levin reported in their study that 59% of the patients informed their orthodontist of pain, but only 21% were prescribed analgesics[36].

Bradley et al. 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[37].Patel et al. evaluated the effectiveness of ibuprofen, naproxen sodium, and acetaminophen. They concluded that ibuprofen was superior to the placebo in relieving postseparator pain as measured by the visual analog scale pain summary scores, whereas acetaminophen and naproxen sodium did not significantly differ from the placebo[15].Nonsteroidalantiinflammatory drugs have been found to reduce the rate of orthodontic tooth movement when consumed for an increased period. A number of studies have been conducted by researchers comparing the efficacy and side effects of various NSAIDs.

Paracetamol, explicitly indicated by most authors as the safest NSAID, seems to be the drug of choice in view of no influence on the range of tooth movement, the risk of root resorption or other adverse effects within oral cavity. According to Shetty et al. acetaminophen showed no significant effect on prostaglandin synthesis and may be a safe choice compared to ibuprofen for relieving pain associated with orthodontic tooth movement[38].Aranteset al. 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[39].

Young et al. showed another drug valecoxib to be administered before the procedure to relieve pain due to initial wire placement[40].

Anesthetic gels

Keim 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.[35] Kwonget al. 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[41].

Low level laser therapy

Low-level laser therapy has been used to relieve pain in patients during various stages of orthodontic treatment. Tortamanoet al. conducted a study in on 60 patients and confirmed that a low-level laser therapy reduced the pain caused after the placement of initial archwires[42].

Fujiyama et al. evaluated the effect of carbon dioxide laser on pain reduction in 60 patients and showed that local carbon dioxide laser irradiation reduced pain without affecting the orthodontic tooth movement[43].

Domínguez and Velásquez reported reduction in pain symptoms on application of low-level laser therapy after activation of final archwires[44].

Vibratory forces

Based on their clinical study, Marie et al. 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[45].

Bite wafers

Mangnallet al. 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[28]. Hwang et al. suggested the use of thera bite wafers in relieving pain after orthodontic procedures[46].

Chewing gums

Farzaneganet al. 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.[37] Benson et al. 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[47].

Chewing gums can be recommended as a suitable alternative to analgesics for pain reduction in orthodontic patients.

Medicated wax

Kluemperet al. 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[48].

Transcutaneous electrical nerve stimulation (TENS)

Roth and Thrash 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[16,50].

Behavioral therapy

Wang et al. provided cognitive behavioral therapy to 150 patients and compared the effects with the use of analgesics. They concluded that the behavioral therapy was effective in pain control during initial stages of orthodontic treatment[49].

II. Conclusion

Orthodontic treatment is associated with a pain and discomfort to patients. 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. The present article has highlighted the orthodontic pain, biomechanics, causes of pain and management of pain.

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