

PAIN CONTROL IN ORTHODONTICS—CAUSES AND MANAGEMENT

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ABSTRACT

Orthodontic patients experience pain and discomfort to a varying degree during the course of treatment. Since pain is one of the important reasons for not seeking the orthodontic treatment, pain control is important both for patient and clinician. In the present article we made an attempt to highlight the various orthodontic procedures which cause pain and discomfort, mechanism of pain and the methods of evaluating the pain. There are various methods of managing pain but analgesics are still the main treatment modality to reduce orthodontic pain despite their side effects. There are some reports suggesting the use of Tens (transcutaneous electrical nerve stimulation) and low level lasers for the control of pain, further convincing research is required to use them as a main treatment modality.

KEYWORDS: Pain, NSAID's, Visual analog scale (VAS), Prostaglandins

INTRODUCTION

Pain is among the most cited negative effects of orthodontic treatment, is of major concern to patients as well as clinicians and is evident in recent publications. Surveys performed to determine the experience of orthodontic pain have rated it as a key deterrent to orthodontic therapy and a major reason for discontinuing treatment. One survey rated pain as the greatest dislike during treatment and fourth among major fears and apprehensions prior to orthodontic treatment¹.

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage².

Dental therapy is often painful, and pain during orthodontic treatment is not much less. It was reported that 95% of orthodontic patients experienced varying degrees of discomfort during treatment^{3,4}. Among the factors that are thought to influence the degree of pain felt by the individual are previous pain experiences, present emotional state and stress, cultural differences, sex and age.⁵ Pain during fixed orthodontic treatment increases gradually from the 4th hour to the 24th hour but returns to a normal degree on the seventh day.^{4,6}

Causes of pain

It is clear from the existing literature that all orthodontic procedures such as placement of separators, arch wire placement and activations, application of orthopedic forces and debonding produces pain in patients. It is also clear that fixed appliances produce more pain than removable or functional appliances and there exists little correlation between applied force magnitude and pain experienced. The various discomforts experienced by patients after appliance placement are often described by them as feelings of pressure, tension, soreness of the teeth, and pain as such⁷.

It is known that the above mentioned procedures will cause pain but what is not known is 'why they cause pain?' It is reported that orthodontic procedures will reduce the proprioceptive and discriminating abilities of the patients for up to 4 days, which result in lowering of the pain threshold and disruption of normal mechanisms associated with proprioception input from nerve endings in the periodontal ligament.⁸ At the same time, there will be pressure, ischemia, inflammation, and edema in the PDL space.⁹

Burstone reported an immediate and delayed painful response after orthodontic force application. He attributed the initial response to compression and the delayed response to hyperplasia of the PDL¹⁰. This hyperplasia has been related to prostaglandins (PGEs), which make the PDL sensitive to released algogens such as histamine, bradykinin, PGEs, serotonin, and substance P¹¹. It is clear that all orthodontic procedures will create tension and compression zones in the PDL space resulting in a painful experience for the patients.

Pain during placement of separators

Creating space mesially and distally to teeth, which are to be banded, forms the initial step in fixed orthodontic mechanotherapy. It is well-known that placement of orthodontic separators results in a painful experience for almost all patients^{7, 12, 13}. Two controlled clinical trials performed, which concluded that there was discomfort associated with separator placement, which usually starts within 4 hours of insertion. The level of discomfort increases over the next 24 hours and decreases to pre-placement level within 7 days^{7, 12}. It is clear that pain is associated with the process of orthodontic separation and starts within 4 hours of its placement with a peak level at day 2 that might last for 7 days.

Archwire placement and activation

Pain is experienced by the majority of patients 4 hours after arch wire placement, which will peak at 24 hours and then decline^{14, 7}. The pain from the archwire placement can be worse in some patients and could even be more than that experienced after tooth extraction. They observed a diurnal variation in pain experienced by patients, with evening and nights showing the highest scores. The pain will usually last for 2 – 3 days and will gradually decrease in its intensity by fifth or sixth day¹⁵.

Comparing various arch wires to determine differences in pain perception showed no statistically significant results. No difference in the intensity, prevalence, or duration of pain between different archwires was found. Patients reported more pain experience in anterior than in posterior teeth because of the differences in root surface area, increased involvement of anterior teeth during levelling, and greater use of anterior teeth for biting^{16,4,7}. Fernandez reported that after 11 hours of force application, a higher pain perception was experienced in the lower than in the upper arch¹⁷.

Removable/fixed appliance

The effect of different appliances (fixed and removable) on pain experience has been evaluated. Found no difference in the level of discomfort produced by fixed or removable appliances¹⁸. Others contradicted this finding and stated that fixed and functional appliances produced a higher intensity of discomfort than removable appliances. Patients wearing fixed appliances reported higher values for intensities of pressure, tension, pain, and sensitivity to teeth.

Orthopaedic forces

Craniofacial orthopedics 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. As part of the inflammatory process, the patient perceives a painful sensation, which is often expressed in the whole craniofacial region.

There are reports in the literature that demonstrate painful experiences after application of expansive force with rapid palatal expanders. Vast majority of children undergoing rapid palatal expansion experience pain, which occurs during the initial phase and diminishes thereafter¹⁹. Approximately 28 per cent of patients reported pain as the factor which prevented them from wearing headgear or elastics. Patients often experience discomfort after 24 hours of headgear wear and there is a sharp decline in pain after 3 days.

Evaluation of levels of masticatory muscle pain and EMG activity in patients treated with protraction headgear concluded that protraction headgear does not induce muscle pain or produce an increase in muscle activity. It is clear that the pain associated with orthopedic devices is not of a muscular nature but a part of the acute inflammatory reaction occurring at the suture regions.

Debonding

Threshold level for patient discomfort at debonding was influenced by the tooth mobility and force application. Intrusive forces were found to produce less pain at debonding in comparison with forces applied in a mesial, distal, facial, lingual, or extrusive direction. Applying finger pressure or asking the patient to bite on a piece of cotton roll to

minimize pain while debonding.²⁰ Use of an occlusal rim wax reduces pain during debonding.

Underlying mechanism for orthodontic pain

The perception of orthodontic pain is part of an inflammatory reaction causing changes in blood flow following orthodontic force application. This is known to result in the release of various chemical mediators eliciting a hyperalgaesic response. Recent research has revealed the molecular basis of orthodontic pain with demonstration of the presence as well as elevation in levels of various neuropeptides released.

Orthodontic tooth movement is known to cause inflammatory reactions in the periodontium and dental pulp, which will stimulate release of various biochemical mediators causing the sensation of pain. The perception of orthodontic pain is due to changes in blood flow caused by the appliances and has been correlated with the release and presence of various substances, such as substance P, histamine, enkephalin, dopamine, serotonin, glycine, glutamate gamma-amino butyric acid, PGEs, leukotriens, and cytokines¹¹.

Complex information arising from mechanical force application induces recruitment of neurons, which act by the way of chemical mediators as modulators of the effector response to the stimulus. Apart from the classic constituents mentioned above, peripheral nerve fibers also participate in the inflammatory process associated with tooth movement. This involves release of neuropeptides after antidromic stimulation of afferent nerve endings and initiation of an inflammatory reaction. These neuropeptides released are known to elicit a painful response.

Factors that influence a pain response to orthodontic force

There exists a non-linear relationship between age, gender, psychological state and cultural background in pain perception following placement of an orthodontic appliance. The relationship between the psychological well being of patients and orthodontic pain perception is proven beyond doubt. It is clear from the published literature that females express more pain than males, and adolescents report higher levels of pain than pre-adolescents and adults.

It is well-known that an individual's 'physiological and psychological susceptibility' can become a significant factor in the intensity of tissue discomfort caused by the physical effects of appliances. It has been reported that the pain experienced by patients does not seem to be directly related to the magnitude of force exerted but relies heavily on the psychological well-being of the individual¹⁹.

Traditionally, it is believed that females are 'fragile' and sensitive to pain, while males are more stoical and can tolerate more pain. Conflicting results have, however, been reported with some showing that males are more willing to tolerate pain than females, but others that there is no differences between males and females in reporting the feeling of pain with respect to threshold²¹.

The 'effect of age' on pain perception is difficult to compare as far as orthodontic treatment is concerned. This is mainly because of the different treatment approaches followed for patients of different ages. However, studies reporting this issue reveal conflicting results. Most favour the opinion that adult subjects perceive more pain than young patients.

Evaluation of pain

In order to study or evaluate pain, patient interview/questionnaire and ratings with Visual analog scale (VAS), McGill pain questionnaire (MPQ), Verbal Rating Scale (VRS) and algometers can be effectively used.

Classifying pain

Burstone¹⁰ classified a painful response to orthodontic mechanics in two ways:

Based on the degree of pain perceived in response to the amount of force application can be divided into:

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 of pain

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 first degree with the passage of time.

Management of orthodontic pain

Pain control during orthodontic treatment should be considered an important aspect of Orthodontic treatment and NSAIDs remain the most preferred method for pain control during orthodontics. Lack of an appropriate protocol for their administration after orthodontic appointments is considered to be a major drawback requiring attention in future research.

The existing literature supports the use of non-steroidal anti-inflammatory drugs (NSAIDs) for pain control, even though other methods (such as anesthetic gel, bite wafers, transcutaneous electrical nerve stimulation, low level laser use and vibratory stimulation) have been suggested.

Numerous studies investigating various drugs such as ibuprofen, aspirin, acetaminophen, misoprostol, indomethacin, naproxan sodium, and recently introduced cox-2 inhibitor, rofecoxib have been published. All agreed upon the fact that these drugs effectively reduce the discomfort and pain caused by appliances by inhibiting or at least reducing the inflammatory response caused by the applied force^{22,11}.

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. The current trend is directed towards use of preemptive or pre-operative analgesics, which are administered at least one hour before every orthodontic procedure. It is clear that, release of PGE, the primary mediators of inflammatory response following force application, will be inhibited by NSAIDs causing a reduction in tooth movement. Evaluation of the molecular level mechanisms behind this process of inhibition, reported an

increase in the levels of MMP-9 and MMP-2 along with collagenase activity followed by reduction in procollagen synthesis after NSAID administration. The whole process is the result of inhibition of cyclooxygenase activity and results in altered vascular and extra cellular collagen remodeling, effecting a reduction in the rate of tooth movement²³.

Pre-emptive or pre-operative analgesic administration to decrease post-operative pain has become the focus of recent research in orthodontics. Pre-emptive analgesia will block the afferent nerve impulses before they reach the central nervous system, abolishing the process of central sensitization¹¹.

Apart from analgesics, other approaches have been tested to reduce pain from orthodontic procedures. An anesthetic gel 'oraqix', which is a combination of lidocaine and prilocaine in 1:1 ratio by weight. The findings suggest that it may be useful when performing orthodontic procedures such as band placement and cementation, arch wire ligation, and band/bracket removal. The advantage of this system is its delivery method, which simply introduces the gel into the gingival crevice. The procedure is reported to be entirely painless.²⁴ Chewing gum or a plastic wafer during first few hours of appliance activation in order to reduce pain has been suggested. This will temporarily displace the teeth sufficiently to allow blood to flow through compressed areas preventing a build up of metabolic products.²⁵

Anecdotal reports on other techniques found in the literature for management of orthodontic pain include vibratory stimulation, transcutaneous electrical nerve stimulation (TENS) and low-level laser application²⁶.

CONCLUSION

Pain management and prevention should be given utmost importance during orthodontic treatment as increased apprehension from patients and parents creates a multi-factorial negative impact of emotional and confidence levels to the patient-parent-clinician triad. In this review an attempt is made to highlight the causes and provide an overview of current management strategies employed for alleviating orthodontic pain. This helps in improving not only the comfort levels of pain of our patients but also smoother practice management.

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