The Concept of Pain in Orthodontic Care

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Abstract

Pain is a subjective sensation that plays a crucial role in physiological illnesses. Orthodontic tooth movement frequently results in pain, serving as a major obstacle for individuals contemplating orthodontic treatment. Moreover, it is a key determinant leading to the cessation of treatment. This review aims to elucidate the notion of pain associated with orthodontic therapy. Nociception, a complex neurophysiological process, involves four component processes: transduction, transmission, modulation, and perception. During nociception, the central nervous system (cortex cerebri) senses the sensation of pain as powerful peripheral stimuli occur.

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1. Introduction

Pain is a subjective and distressing sensation that is neither transferable nor communicable to others. Each person will have unique responses and interpretations. Variables such as cultural influences, age, environmental circumstances, support systems, previous encounters, anxiety, and stress impact both the psychological and physiological dimensions of pain. The International Association for the Study of Pain defines pain as a distressing subjective and emotional experience that is linked to real or potential harm to bodily tissues or the circumstances in which such harm occurs. Pain intensity refers to the degree of severity with which an individual experiences pain. Measuring pain intensity is very subjective and varies from person to person. It is important to note that individuals may perceive pain of the same intensity in vastly different ways. The most probable method for objectively measuring pain involves utilizing the body's physiological reaction to pain.1,2

Orthodontic tooth movement is the result of applying external forces to the teeth. Orthodontic pressures induce the displacement of teeth within the periodontal ligament space. This phenomenon results in regions of compression and regions of tension. For instance, the application of stimuli initiates the processes of bone resorption and apposition. These responses alter the morphology of the alveolus. This enables modifications in the tooth's position. These methods entail the stimulation of nerve endings in the
periodontal ligament and the subsequent initiation of an inflammatory reaction, which commonly results in the sensation of discomfort. Orthodontic tooth movement frequently results in pain, which serves as a major deterrent for individuals contemplating orthodontic treatment. Moreover, it is a key determinant leading to the cessation of treatment. The purpose of this review is to elucidate the notion of pain associated with orthodontic therapy.

**Variables impacting the reaction to pain**

**Age**

Age significantly influences the perception and expression of pain. The pain response in adult patients differs from that in the elderly. According to a study, older individuals necessitate a greater level of pain stimulation compared to younger individuals. Contrary to other findings, some research suggests that there is no discernible disparity in pain perception between younger individuals and older individuals.

**Gender**

Gender can exert an influence on the pain response. A study reveals gender disparities in pain responses, indicating that women exhibit superior pain tolerance compared to men. Women have heightened pain during menstruation due to hormonal fluctuations, but teenage boys who engage in regular exercise tend to have a reduced sensitivity to pain, as exercise is linked to a natural decrease in the pain threshold.

**Pain duration**

Based on its duration, pain can be categorized as either acute or chronic. Acute pain manifests abruptly, but chronic pain is enduring or sporadic discomfort that endures for an extended duration. There are three levels of pain categorization: mild pain, which has low intensity; moderate pain, which triggers both physiological and psychological responses; and severe pain, which is characterized by high intensity. In order to obtain precise measurements of pain, it is necessary to collect data on the severity of pain.

**Pain categorization**

Pain is characterized as a subjective sensation and is a significant aspect of physiological illnesses. Pain is a universal experience that can impact anyone, irrespective of their gender, age, race, social class, or employment. Nociceptive pain, inflammatory pain, neuropathic pain, and psychogenic pain categorize pain. Nociceptive pain, also known as physiological pain, is a transient sensation of pain that occurs in reaction to harmful stimuli. Patients are typically reluctant to seek medical attention for such discomfort, as it usually resolves spontaneously without intervention. Nociceptive pain is characterized by a direct relationship between the intensity of the stimulus and the severity of the pain. Orthodontic care typically causes physiological pain. Inflammatory pain arises spontaneously as a result of tissue injury and inflammatory processes. Neuropathic pain arises from basic abnormalities or malfunctions in the neurological system. Individuals diagnosed with diabetes mellitus frequently experience this form of pain. Individuals report psychogenic pain in the absence of any identifiable biological pathology. According to a study, functional pain arises from anomalies or disruptions in the functioning of the central nervous system, resulting in heightened sensitivity to different stimuli.

**Anatomy and innervation in orofacial pain**

Orofacial discomfort refers to pain that is associated with the head and neck. Orofacial pain refers to the presence of discomfort and impaired functioning that affect the transmission of both motor and sensory signals within the trigeminal nerve system. The involvement of numerous anatomical and physiological components makes orofacial pain more intricate and multifaceted compared to pain experienced in other areas of the body. The trigeminal, facial, and glossopharyngeal nerves transmit neural signals originating from the orofacial structures towards the central nervous system. Additionally, these signals pass through the second and third cervical segments, originating from a specific region.
located at the mandible’s angle. The key anatomical locations involved in orofacial discomfort include the epidermis, mucosa, dentin pulp, periodontium, periosteum, blood vessel walls, and temporomandibular capsule. Physical stimuli, such as pressure, stretching, tension, or alterations in pH, can trigger orofacial pain.\textsuperscript{11,12}

**A course on pain**

Pain follows a sequence of intricate neurophysiological processes called nociception, which consists of four main stages: transduction, transmission, modulation, and perception. During this process, intense impulses in the peripheral nervous system eventually lead to the sensation of pain in the central nervous system (cortex cerebri).\textsuperscript{13,14}

**Transduction process**

A variety of stimuli, such as biological, mechanical, thermal, electrical, radiation, and others, cause nociceptor activation at the body's edges. This starts the pain process at the transduction stage. The application of pressure and similar factors leads to tissue damage, which triggers the production of prostaglandins. These prostaglandins, in turn, sensitize nociceptive receptors and prompt the release of pain mediators like histamine and serotonin, resulting in the perception of pain. The medical term for this condition is peripheral sensitization.\textsuperscript{10,11}

**Transmission procedure**

The transmission of impulses through sensory nerves occurs as a result of the transduction process, specifically through A-delta fibers and C fibers. These impulses travel from the periphery to the spinal cord, where they undergo modulation. The spinothalamic tract and certain parts of the spinoreticularis relay these impulses to the thalamus. The spinoreticularis is particularly responsible for carrying stimulation from deeper and visceral organs. The pain associated with this condition is characterized by its widespread nature and its emotional component. These nerve fibers also form synapses with larger, myelinated nerves, transferring pain signals to the thalamus and somatosensory cortex in the brain, resulting in a sense of pain.\textsuperscript{8-12}

**Modulation process**

Modulation refers to the transmission of pain signals throughout the central nervous system, which includes the spinal cord and brain. The brain regulates the ascending process between the body's endogenous analgesic system and pain information entering the posterior horn of the spinal cord. Endogenous analgesics, such as enkephalin, endorphin, serotonin, and noradrenaline, have the ability to inhibit pain signals in the posterior horn of the spinal cord. The posterior horn acts as a gateway that can regulate the flow of pain signals in order to facilitate the action of endogenous analgesics. The individual subjectivity of pain perception attributes this phenomenon.\textsuperscript{6,7}

**Pain perception**

Pain perception, a subjective process, is the ultimate outcome of a complex interplay including transduction, transmission, and modulation processes. This process takes place in the thalamus and involves sensory discrimination in the cortex.

**Pain intensity**

Pain intensity refers to the degree of severity with which an individual experiences pain. Measuring pain intensity is very subjective and varies from person to person. It is important to note that individuals may perceive pain of the same intensity in vastly different ways. Utilizing the body's physiological response to pain is the most objective method for evaluating pain. Measurements obtained with this technique are unable to offer a conclusive depiction of the pain itself. Patients experience the highest level of pain within the initial twenty-four hours following orthodontic treatment, which may persist for the subsequent two days. Additional studies indicate that the discomfort intensifies within the initial four hours and reaches its maximum level within twenty-four hours following the
placement of the separator during orthodontic treatment.9-11

2. Conclusion
Pain follows a sequence of intricate neurophysiological processes called nociception, which encompasses four distinct stages: transduction, transmission, modulation, and perception.

3. References