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Music Therapy and Its Role in Pain Control

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Abstract

Music has occupied our day-to-day life; as it is readily available, accessible and further technological advancement has made access to music a common norm. Music has been present since the very early part of human evolution and has helped in forming society and civilizations. It has served various purposes like social cohesion, emotional expressions, interpersonal communication as well as recreation. Due to its great bonding power; it is important in terms of social dynamics. Music therapy is convenient, inexpensive and user-controlled and seems to be influencing the physiological system positively if rightly used. Vast research is going on to find the right music that could be having a beneficial therapeutic effect. Music seems to affect the pain perception, modulation and also has the affective component to help positively in controlling the pain. This chapter is an attempt to evaluate the various pain modulating effects of music through a systematic music therapy intervention using the vast research work done in this field. This review is consistent to integrate the best scientific evidence for pain relief into practice, education, and research. Music being a non-pharmacologic, nontoxic intervention and is free from adverse effects and also is an inexpensive, low cost modality.

Keywords: music, human physiology, pain perception, pain control, music therapy, audio analgesia

1. Introduction

Music has marked its presence in every society past and present. It is considered omnipresent and is culturally universal. Each ethnic group, society may be a remote isolated one, has its music. Music is considered a universal way of communication and means of expression of feelings for mankind [1]. The existence of music can be ascertained from the existence of mankind as old as 2,00,000 years back. Evolutionary biologists consider music as a binding force between individual members of society and its existence was said to even predate the speech and language functions. It is said that music has great bonding power and has played role in creating society and civilization from each of the individual members. Music is been used as a form of leisure relaxation as it was used for recreational purposes. Historical evidences point out that music was used as therapy form Egyptian medical Papyri dating back to 1500 years, so as the Arab, Chinese, Indian and Greek literature mentioned the use of various notions of music as therapy. The ancient Egyptian civilization used musical songs for the healing of sick individuals. Likewise, music was considered as an art of medical healing by Hippocrates [2, 3]. The present

chapter describes the pain-alleviating effect or analgesic effect of music using results put forward by the various research studies. The pain modulating effect of music is a prime one as the suffering causes the pain and brings about the agony at the level of mental as well as the physical state. The impact of music therapy on pain perception and its application as a form of treatment has been described in this section.

2. Physiology of pain perception

As per Sherrington, Pain is defined as “the psychical adjunct of an imperative protective reflex.” Since there are definite receptors, nerve fibres, tracts and higher centers for pain perception, it is a part and parcel of a protective reflex mechanism. Similarly, from the definition of pain, it can be concluded that pain perception itself is a protective reflex against a harmful stimulus, and is an adjunct or added signal in consciousness accompanying this reflex [4]. Similarly, according to the International Association for the Study of Pain, pain is “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” [5]. Pain sensations are conveyed from the periphery towards the brain using specific neurons through spinal cord to thalamus and to cerebrum. At the level of the Cerebrum, pain perception and higher abilities like detection of pain form specific body part is done. Pain is a unique type of sensation in that it persists as long as tissue damage or painful stimulation is there. It is the non-adapting type of sensation. Functionally there are two types of pain as per the speed of pain impulses travelling through the peripheral sensory nerve fibres. The slow pain is carried by slowly conducting type C unmyelinated pain fibres which evoke the slow but dull type of pain. The fast pain sensations which are evoked within a fraction of seconds after applying painful stimulus and cause a sensation of sharp pain is carried by

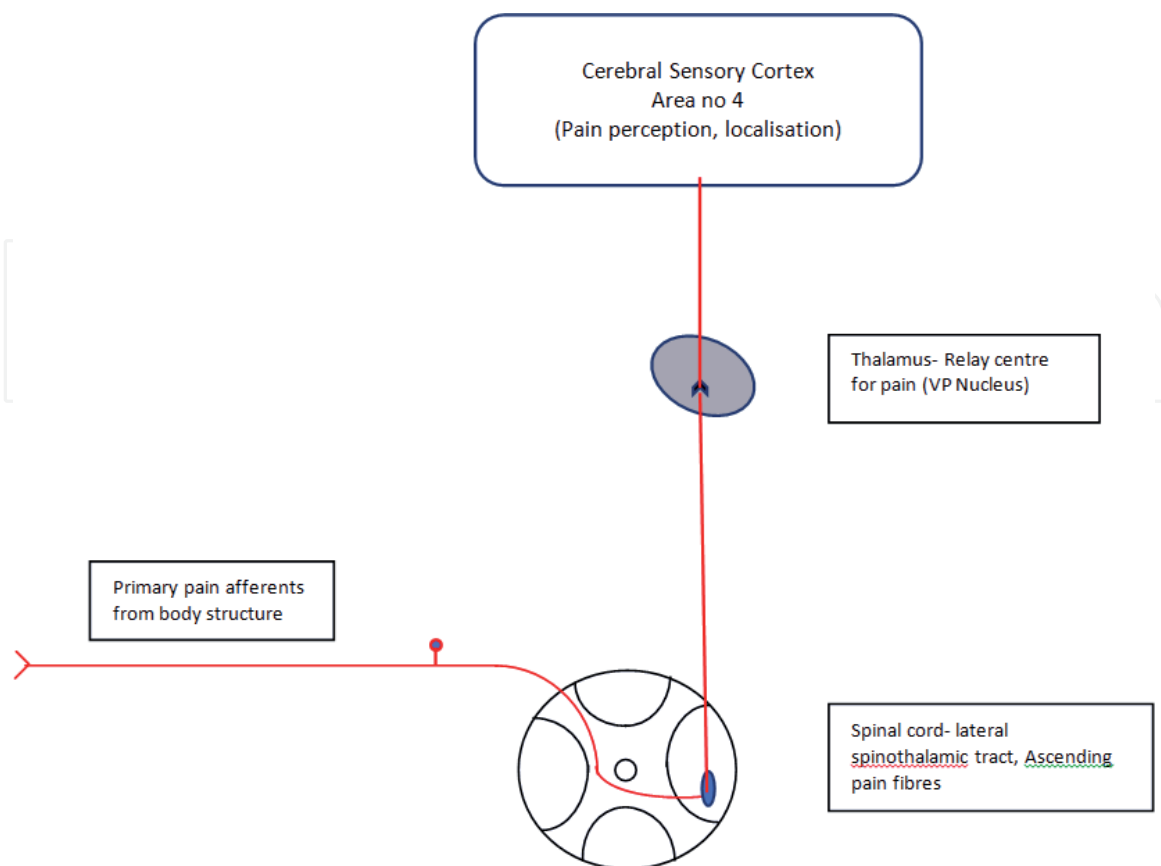


Figure 1.
Pain pathways from periphery to cerebral cortex.

A δ (delta) myelinated nerve fibres. The pathways are somatotopically arranged in the contralateral half of spinal white matter in form of anterior and lateral spinothalamic tracts. The fibres ascend from these tracts to the VP (Ventre-posterior Nucleus) of the thalamus. The thalamus is the first relay center for pain. From where second-order neuron travel to Sensory cortex of cerebral hemisphere to final terminate in this area. The pain pathway is illustrated in **Figure 1**.

3. Analgesic effect of music

Listening to music can influence the pain sensation through the various proposed mechanism. There is a Descending Pain Modulating System (DPMS) in the body which can inhibit and modulate pain sensation arising from various body parts. The DPMS acts on the pain afferents (nociceptor fibres) and decreases the nerve impulse transmission through them leading to decreased pain perception. It has been suggested that the analgesic effect of music is aroused in the brain and acts through a top-down regulation through DPMS [6]. Further, it has been observed that self-chosen music has a higher analgesic effect than researcher-chosen music. Stress has also been a predisposing factor in chronic pain and amelioration of stress can influence the pain positively [7]. Hence for this analgesic effect, the term 'Audio analgesia' was proposed and used by Gardner and Licklider for effective pain management during dental procedures [8]. However, the underlying mechanism of Audio-analgesia remains to be elucidated as does the direct effect of music on pain amelioration and the indirect effect with the coping up of pain. One proposed mechanism could be due to improved control over pain that may be achieved via distraction from pain or via induced relaxation effected by the music [9–11]. Further, it has been studied that listening to music can reduce the intensity of pain and the requirement of opioid analgesics for post-operative pain [12]. Although, the positive effects associated with music listening on various physiological and psychological parameters have been demonstrated, the effect of music on pain perception was reported to be a small one. However, music listening is associated with a reduction in pain-related distress [13]. Further stimulation of the parasympathetic nervous is implicated in the analgesic effect of music [14]. Pain control through music Researchers have worked on the mechanistic explanation of the analgesic effect of music and the most important mechanism proposed for the same is through the gate control theory and pain neuromatrix theory. Music exerts its effect on pain modulation by affecting the cognitive and emotional processes associated with the music stimulus. The net result of music therapy yields as actual pain modulation as it is perceived at the levels of the Central nervous system (**Figure 2**).

There are two theoretical explanations for the analgesic effect of music on pain control, the first one is the ability to use music freely at any time while in pain that provides the subject "a feeling of control" and the ability to do something to counteract the negative experience [15]. Listening music is itself a distraction of attention from the pain and the painful stimulus [16]. Such distracting effect allows limited mental resources for pain perception [17]. Further, if the stimulus provokes emotional engagement, it acts as strongest distraction [18]. The attributes of music are involved in this emotional engagement as evidenced by the listening to the pleasantly valenced music that brings about the positive emotional induction which lies beneath this music's effect [19]. Indeed, the analgesic effect or pain-relieving effect largely resides on self-selected or participant selected music rather than the supposedly relaxing or calming music. The beneficial effect of music on pain modulation is due to the raised level of involvement with the music and this is related to past association and familiarity with music and cultural context as well [9].

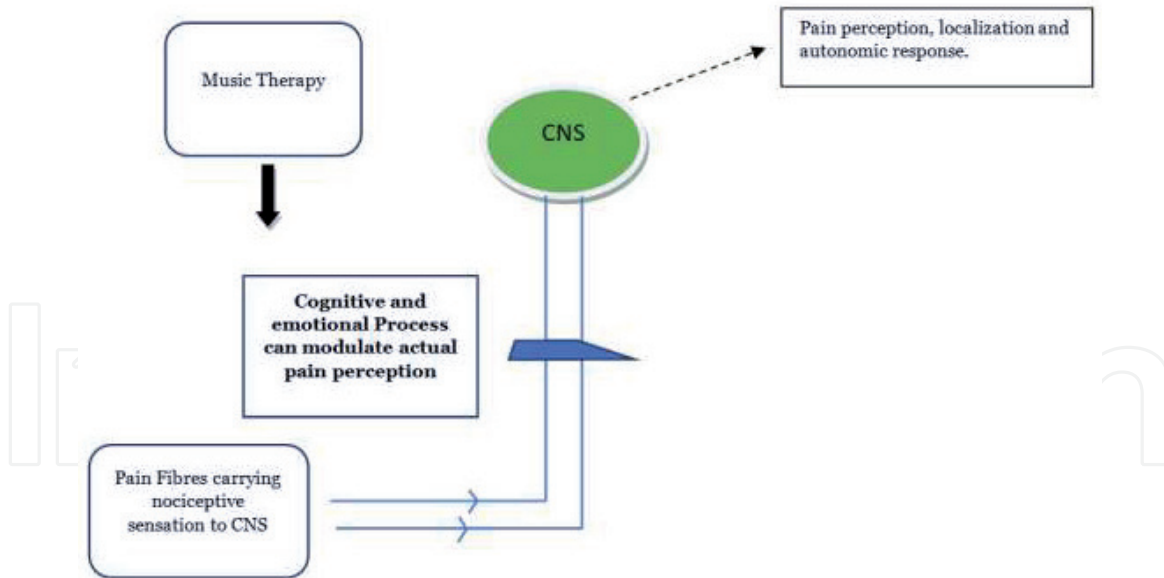


Figure 2.
Pain modulation pathway for music therapy.

Various experimental studies using music as a tool for pain relief have revealed that the self-selected music was associated with increased pain tolerance, increased perceived control over the pain, decreased anxiety, and decreased pain intensity as compared to white noise, arithmetic distraction, visual distraction and silence. The analgesic effect of music possibly lies in the emotional engagement of the listener which distracts the listener from the noxious stimuli. One of the commonest goals of music is to influence emotions and affect. Sloboda [20] there is marked agreement between different listeners about the emotions expressed by the music having different cultural backgrounds [21]. As per the Knox et al. [22] who studied the effect of participant chosen music on pain relief of experimentally induced pain. It was concluded that music content and structure have a role in the music choices made by participants and the efficacy of music listening for pain relief. The music chosen for pain relief by the participants chiefly expressed contentment and further it is stated the participant's emotional engagement with music and distraction from pain are dependent on the acoustic content and emotion expressed by that piece of music. A specific physiologic mechanism for pain relief using music has not been elucidated. However, decreased pain may be related to endogenous pain modulation and psychological outcomes including reduced anxiety, relaxation, improved mood, distraction [23]. Beck in his study on music therapy and pain relief of chronic cancer pain reported a twice greater decrease in pain with music than with sound in advanced cancer patients. The analgesic effect of music therapy was largely ascribed to distraction caused by music stimulus which has been supported by frame work theory. Music aroused emotions which have an impact on affect and cognitive function which accounts for improved mood, decreased anxiety, and increased control and distraction, all potentially reducing pain [24].

4. Music therapy as an intervention for pain relief

Music therapy is defined as a “controlled method for listening to music, making use of its physiological, psychological, and emotional impact on the individual during treatment for an illness or trauma” [25]. The principal factors that could decide the success of music therapy sessions are:

- The patient's taste and cultural background shall decide the choice of music.
- The instrumental music shall be administered for 20–30 minutes through earphones while wearing an eye mask, in a relaxed position.
- The session should be supervised and conducted by care staff, and particularly nurses.

Similarly Music therapy is defined as an effective and reliable source of treatment that helps the patient in the reduction of pain, anxiety, anguish without the need for medication [26]. The American Music Therapy Association defines music therapy as the prescribed use of music by a qualified person to effect positive changes in the psychologic, physical, cognitive, or social functioning of individuals with health or educational problems. Similarly, the British Association of Music Therapy has also defined music therapy as “an established psychological clinical intervention” that helps people “whose lives have been affected by injury, illness or disability through supporting their psychological, emotional, cognitive, physical, communicative and social needs.” Music therapy based on self-selected or participant selected music could be improved with the use of instrumental music, preferably low tones with strings than to brass or percussion, and shall have a decibel intensity not greater than 60 db [27]. Similarly, the music selection is recommended to match the average heart rate of 60–80 bpm for promoting positive outcomes on pain and relaxations [28].

There has been a priority for research in the field of appropriate music that can have a positive impact on pain relief. Music listening can be a form of behaviour therapy and non-pharmacological intervention that can reconfigure the individual to anticipate, perceive and respond to pain. Such intervention can ensure adherence to drug therapy and make pain a manageable issue. Music as a modality can stimulate “Synesthesia”—a neurological phenomenon in which stimulation of one sensory or cognitive modality causes an automatic, involuntary experiences in a second sensory or cognitive pathway. A form of synaesthesia is seeing vivid colours upon hearing music. Like other positively valenced stimuli such as food, sex, money, psychoactive agents' music is akin to stimulate and activate the reward, reinforcement, motivation pathway in the human mesolimbic cortex [29–31]. Functional MRI studies have seen maximum Dopamine response with anticipation of, listening to participant selected pleasurable music in the respective brain structures [32].

It has been reported that listening to well-liked pleasant music enhances neuronal functional connectivity that can influence the valence and reward characteristics of multimodal sensory processing in patients suffering from chronic pain [33]. Pleasurable music can change neuronal pathways in patients suffering from pain. The diagrammatic representation for the putative mechanism of music therapy in pain relief through its actions of Gate control theory and neuromatrix theory is presented in **Figure 3**.

Individualised personal tailoring of self-selected music can be achieved by three ways as proposed by [34].

1. active personal curation (e.g., an individual searching for music and adding,
2. it to a personalised playlist),
3. professional curation (an authority in music curating content), and perhaps most appealing,
4. automated discovery.

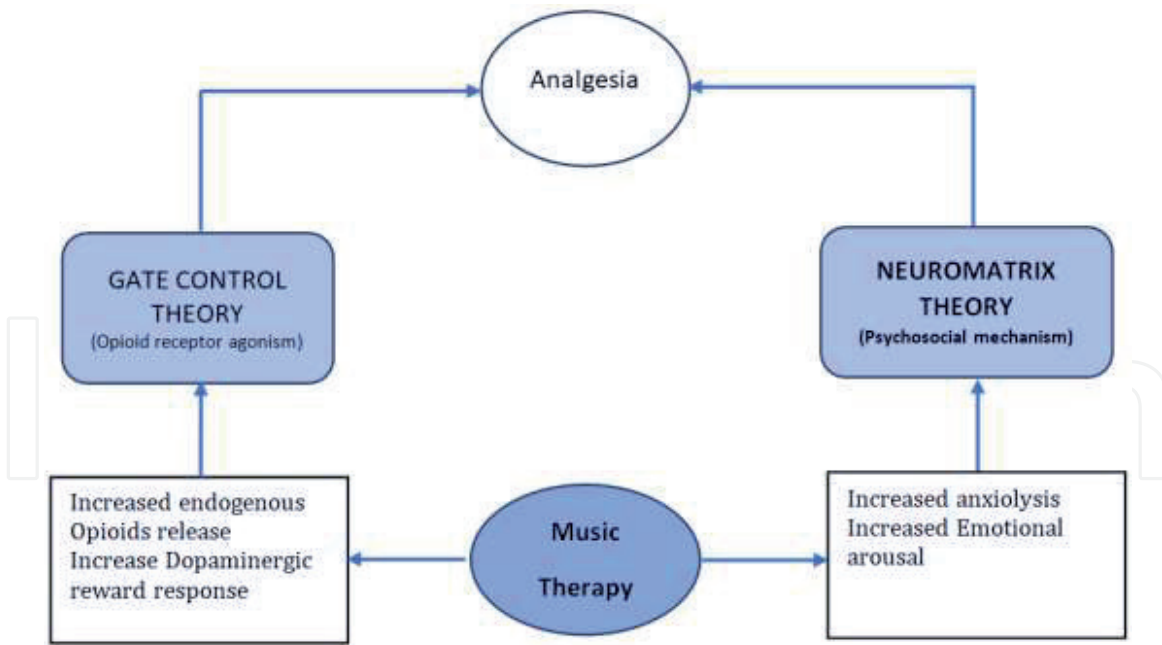


Figure 3.
Mechanism of music therapy in pain relief through the Gate control theory and neuromatrix theory.

Pain and anxiety are coexistent in critically ill patients. Pain can trigger anxiety due to fear and uncertainty as with other factors like associated treatment of the ailment and noxious stimuli. Persistent pain induces a widespread sympathetic response, sleep disturbances and altered appetite pattern and increase the anxiety. Similarly, coexistent anxiety precipitates excessive pain leading to a positive feedback cycle. Music is a powerful distractor. Music listening is a powerful distracting disengaging stimulus that occupies the discrete brain pathways with pleasurable stimulus instead of noxious or anxiety-provoking stimuli. It has been proposed 60–80 bpm simple music composition achieves relaxation [26]. A general rule of thumb has been proposed for relaxation and anxiety reduction purposes. The music listening shall be for minimum twice daily for at least 20–30 min in a comfortable environment and comfortable patient position. The patient should be encouraged to self-direct the duration and frequency of listening to the self-selected music. As music has a varied preference, there should be encouragement from family members as well as the patient to choose favourite selection for the music.

Further, the method of music delivery should be considered carefully and it is recommended to use headphones or earbuds for effective individual target. As music for one subject may be perceived as noise or noxious stimulus by others [35]. Guetin has reported from the finding of single-blind RCT that the music intervention can be an effective tool in managing chronic pain in medical conditions like lumbar pain, fibromyalgia, inflammatory disease, or neurological disease. The music intervention has a huge impact on pain reduction as well as associated anxiety as well as depression and also leads to a significant reduction in the requirement of analgesic medications [36].

However, as per Cepeda, music should not be considered a first-line treatment for pain relief as the magnitude of its benefits is small. However, it is an important non-pharmacological adjunct for achieving effective pain control since listening to music for treatment of pain offers potential advantages of low cost, ease of provision, and safety [12]. The challenging task for Music therapist is designing clinical protocols that could be effective in helping people manage differing types of pain. Further, music therapist is crucial in teaching people to fully listen to that music and also to appreciate its effect on themselves. They are also involved in teaching the patient to

get engaged with the music so that pain perception is overcome by multiple sources on multiple levels. The various interventional techniques used by music therapy include singing, playing instruments, rhythmic-based activities, improvisation, composing/song writing, in addition to listening to music. Thus, this active music intervention has also been found to be useful in pain control [37]. As proposed earlier music affects the gate control theory of pain by acting on cognitive components. Likewise, by arousing emotions which in turn influences cognitive abilities and thus modulates the pain. Västfjäll et al. [38] music as a source of pleasure enables pain reduction and overall pain sensation [39]. Music can be considered as the relevant stimulus for releasing thoughts and feelings and has a positive influence on healing. Music intervention can be used to reduce post-operative pain and anxiety in patients undergoing biopsy procedures. Music listening can lead to the expression of nitric oxide, opiate, cytokine and hormone expression in listeners [33]. The engagement of these neurochemical systems, can drive the subject to a state of calmness and relaxation [32]. Similarly, because of its effect on emotions music, music can help achieve an anxiolytic state and effective pain control.

Modern-day medicine practice uses music therapy widely in various physical, psychological, functional and educational settings to help improve the physiological and psychological status of patients. Park H has studied the effect of self-selected music on pain for home-dwelling persons with dementia. Pain levels were measured for the 30 min before listening to music, the 30 min while listening to the music, and the 30 min after listening to the music. The scores of Modified Pain Assessment in the Dementing Elderly (M-PADE) were used for assessing the pain levels with music intervention. There was no significant reduction in pain while listening to music, but pain levels were reduced after listening to the music compared with baseline. Based on the findings of the study, listening to music at least 30 minutes holds promise to assist in the control of pain [40]. Over many years there is the evolution of a wider range of pain management techniques that are based on the prime gate control and neuro-matrix theory of pain [41, 42]. The strategies that can distract the subject' attention away from the sensory and emotional reactions brought out by noxious stimulation at the basic level is the most intuitive strategy and appealing one [43]. Using the effect of distraction Mitchell LA I studied the effect of three different distracting stimuli respectively music, arithmetic task and humour on experimental pain control. Preferred music listening was found to be resulted in a significantly longer tolerance of painful stimulation than a mental arithmetic task as does the ratings of perceived pain control using the music [11]. Dolores et al. studied the effectiveness of music therapy in chronic pain management in patients with fibromyalgia. The study findings concluded that listening to music at least once a day for ≥ 30 min for consecutive 4 weeks of music therapy can help to assist in pain control in people diagnosed with fibromyalgia. Further, it was proposed that Music therapy can be used as nursing as well as a self-management intervention to reduce pain and depression [44]. One form of pain which is associated with cancer is detrimental to the quality of life of the patient as it increases the patient anxiety. Krishnaswamy P evaluated the role of 20 minutes of music therapy in pain control in patients with cancer. The results of the study indicated that music therapy was found to lower the pain score (Numerical rating Scale) of a patient who had received standard palliative care for pain reduction. It was also more effective than the act of talking in reducing the pain score [45].

5. Conclusions

Owing to positive effects, music has on human pain perception and its capability to alter the pain sensation and pain perception along with associated anxiety, sense

of loss of control. The modern medicine practice described music therapy as an evolving branch that is convenient, easy to administer, patient complaint, non-pharmacological, non-dependence producing strategy for pain modulation. The most seemingly positive effect of music on human pain relief also lies in its reward value and positive emotions associated with it. Similarly, by ameliorating associated stress, the uncertainty it is useful at the mind as well as somatic level. It can be concluded that Music Therapy and music therapist will be having a definitive role to play to achieve the mind-body harmony and optimum health in the management of chronic pain.

Conflict of interest

The author declares no conflict of interest.

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