

## **A Brief Neurobiological Review: Indian Classical Music and it's Therapeutic Effect on Physical Pain**

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### **ABSTRACT**

Everyone agrees, aches and pain are normal part of human life. No doubt, chronic pain severely affects subjective wellness of a person. A recent Indian study found that chronic pain has higher prevalence in Indian adult's population as compared to other Asian populations. They concluded that chronic pain emerging as a major public health care problem in India. The therapeutic effect of music was well recognized in Ancient India. It has a considerable role in chronic pain management as a part of multidisciplinary approach of pain rehabilitation. The specific Ragas and Talas generate appropriate and positive emotions, and also, it acts as a component to stimulate inner dynamics of the participants. Observing certain ragas itself can increase our metabolic activities and balance our emotions besides, alleviate physical pain. Either re-creative model or receptive model of musical intervention can improve and stimulate neuronal connectivity, especially in sensory areas and auditory and motor cortex. Frontal and Temporal regions, Sensory Motor Neurons, Basal ganglia, Supplementary Motor Area, Cerebellum and even Mirror Neurons have greater involvement in perception and production of music. Therapeutic application of music often involves activation of certain motor function, cognition, imagination, realization or covertly experiencing positive mood or ventilating distressed feelings. Ragas such as Aanandabhairavi, Kapi, Hindolam, Mayamalavagoula, Yamuna Kalyani, Neelambari Chalanatta, Ahirbhairav, Darbari Kannada, Hindol, Jaijai Wanti, Nat Bhairavi, Yaman, Madhuvanti, Sohani, Gunakali are also found to be highly effective in reducing various physical pains. However, only few researchers systematically evaluated and conceptualized the wide potential benefits of Indian Classical Music.

**Key Words :** Music Therapy, Classical Music, Physical Pain, Neural Mechanism, Stimulation, Ragas

### **INTRODUCTION**

It is an unfortunate reality in human life that we all constantly experience pain either physically or emotionally in one way or in another. Everyone agrees, aches and pain are normal part of human life. Simply we can state that 'pain is an unpleasant physical or emotional feelings caused by illness or stress'. According to the International Association for the study of Pain, it is defined as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (Treede, 2018). Mc Caffery (1968) stated "pain is an unpleasant sensation of suffering

or distress occurring in different degrees of severity due to a result of a diseases or a physical injury". There has been a considerable increase in depression and risk of suicide involving chronic pain conditions (Cheatle, 2012). Research confirms that chronic pain conditions are interlinked with elevated risk for suicide (Hooley *et al.*, 2014). No doubt, chronic pain severely affects subjective wellness of a person. A recent Indian study found that chronic pain has higher prevalence in Indian adult's population as compared to other Asian populations. They concluded that chronic pain emerging as a major public health care problem in India (Saxena *et al.*, 2018).

Literature states that the scientific study of pain in

modern sense was began around two centuries ago and from last few decades, there have been a significant development in scientific knowledge as well as therapeutic management of pain related conditions (Bonica, 1987, Lasch *et al.*, 2002). We know drugs such as Acetaminophen and Non Steroidal Anti-inflammatory medicines have a cardinal role in treating chronic pain, moreover, physicians go for further investigation as well as management when pain persist.

Now it has been well established that music has a considerable role in chronic pain management as a part of multidisciplinary approach of pain rehabilitation (Strzemecka, 2013). The therapeutic effect of music was well recognized in Ancient India. Practically speaking, from ancient nada yoga and Raga Chikitsa systems to various modern classical mode of intervention has a wide range of potentialities to alter our mind and body (Sairam, 2012). It is clear that our traditional classical music has certain covert and overt components which can affect our current psychological (Psyche) and physiological (Soma) state. Many Indian scientific observations reveal that music therapy can be used effectively as a preventive as well as supplementary to the main treatment after the onset of any pathological conditions (Chakraborty *et al.*, 2018, Sanivarapu, 2015). In this paper, we are trying to succinctly note the therapeutic effect of Indian music and neurobiological facts underlying music related interventions. Let's start with a brief History.

### **History of Indian Music:**

The root of the Indian classical Music originates from Vedic period *i.e.* Natyasastra, which was attributed to Sage Bharata Muni (Mehta, 1995). Since then systematic music practice became an integral part of Indian culture and gradually moulded into two different forms. It was somewhat observable during the period of Mughals. During Mughal era, Indian Classical Music tradition evolved into two distinct systems, the Hindustani and Carnatic Systems. While, the North Indian Classical Music tradition was much influenced by Persian Arts, especially in South they followed unique style of vocal music composition.

Basically Indian Classical Music has two intramural elements called Raga and Tala. Specific Swara (notes) helps to form a melodic structure along with a time cycle called the Tala. Some historians points that common 'swaras' were connected and compared to the sounds produced by birds like peacock etc. (Sambamurthy, 1999).

The period of Purandaradasa, carnatic music became systematized and through his peerless effort, various schools had been developed. He was both composer and singer. Some literature claims that Purandaradasa, the 'Pitamaha' (Grandfather) of Carnatic Music, might composed more than Four Lakhs Kirtanas during his life time and majority of his works were lost; only few of them survived and accessible today (Zydenbos, 2012, Parthasarathy, 1991). Since then, many musicians came forward to propagate Carnatic music. By the end of the 16<sup>th</sup> century Carnatic style became most influential Music tradition in South India. Ariyakudi Ramanuja Iyengar 1892-1967 popularised various forms in Carnatic Music. He was credited with establishing the modern form of Kacheri (concert). The Urdu word 'Kacheri' denote musical concerts once held in the courts of the Muslim rulers in North India. Muthuswami Dikshitar, Tyagaraja Swamikal, Syama Sastri were called the trinities of South Indian Music (Panikkar, 2002). Similar to South Indian tradition, Hindustani North Indian Music acquired its modern form by 15<sup>th</sup>-16<sup>th</sup> centuries. During that time north India was under the influence of Mughal Empire. They were much fascinated with Persian and Arab culture. By 16<sup>th</sup> century Tansen innovated Hindustani Music and it became predominant musical tradition in North India. Bruno Nettl (1995) stated that Tansen was the founder of Hindustani Music, his musical performances inspired many noble people of that time. Gradually four major forms Dhrupad, Khayal, Tarana and Tumri emerged in Hindustani Music. Many scholars pointed that Hindustani music had been emerged by Arab Music influences but still the nature of their influences are unclear (Te nienhuis, 1974). Although Indian Classical Music has different perspectives, no doubt, it has an eminent position in world music, especially for its therapeutic effect. Let's check how does it work.

### **Raga Chikitsa, How it work?:**

'Raga Chikitsa' means 'curing through the use of Ragas'. Traditional Indian Classical Music is also being widely used as therapy for assisting various medical treatments. In both systems *i.e.* Carnatic and Hindustani classical traditions each ragas represent specific emotions (Chakraborty, Chandra and Chakraborty, 2018). These specific Ragas and Talas generate appropriate and positive emotions, and also, it acts as a component to stimulate inner dynamics of the participants. Studies confirm that simply observing certain ragas itself can increase our

metabolic activities and balance our emotions besides, alleviate physical pain (Sarkar and Biswas, 2015, Redding *et al.*, 2016). This might be because of the influence of Vedic hymn and distinctive Persian melodies were known for stimulate positive- emotions (Kaufmann, 1965). Either experiencing (Listening) or practicing (performing) these music alone bring positive effect on their minds. For instance, 'Raga Shree' can evoke relaxation as well as serenity which can improve pain related conditions (Mathur *et al.*, 2015). A body of research confirms that, systematic music procedures (Music Therapy) could improve mental flexibility and emotional adjustment (Thaut *et al.*, 2014, Thaut *et al.*, 2009). According to American Music Therapy Association (2011) Music is a form of 'sensory stimulation' that provokes responses due to the familiarity, predictability and feelings of security associated with it.

Music Therapy can modify not only our senses; can revitalize our higher order cognitive functions too. It means, attending systematic music procedures can improve our problem solving skills, emotional coping skills and cognitive appraisals. Paying attention to specific ragas being preferred for a particular disease produces a network of sound stimulation in brain. This network of stimulation would pass to entire body, including the affected part by nerves. It also has a unique capacity to create positive emotions. Furthermore, it helps to maintain a psycho- physiological equilibrium. For example, 'music timing' (Tala) has incredibly close connection with our heart beats (Ulrich, Houtmans and Gold, 2007). Rhythm perception and Rhythm entrainment (Bowmer *et al.*, 2018) simultaneously alters our cardiovascular and brain functions. Likewise, systematic flow of blood, oxygen and other nourishments creates a positive stroke on brain and body (eg. Deep Relaxation or Self awareness). Although it instantly alleviates mental tension, subsequently it can also reduce muscle tension. Overall, the therapeutic nature of Indian traditional music has a unique place in the world. Let's see more about neurobiological facts.

### **Neurobiology of Music Therapy:**

Pain- reducing effect of music, either through experiencing or practicing has been well documented in the literature (Sihvonen *et al.*, 2017, Linnemann *et al.*, 2015, Zatorre, Chen, Penhune, 2007, Koelsch, 2014, Sarkamo, Tervaniemi, Huotilainen, 2013, Alluri *et al.*, 2012). As an alternative mode of symptom management

and optimizing the physical function of human body, music based interventions have proved an exceptional potentiality. However, the core neuro-biological mechanisms underlying its therapeutic effect still under research especially potential pain reducing effect remain understudied (Linnemann *et al.*, 2015). Certainly, music listening or performing improves one's subjective feelings. According to Justin and Laukka (2004), our main motivation for engaging with music are experiencing, and regulating emotions. Emotions are deep feelings which color our life. Music can ease pain through reducing pain sensation and limiting subjective stress level (Sihvonen *et al.*, 2017, Chanda and Levitin, 2013, Linnemann *et al.*, 2015).

Either re-creative model or receptive model of musical intervention can improve and stimulate neuronal connectivity, especially in sensory areas and auditory and motor cortex (Alluri *et al.*, 2012, Sarkamo, Tervaniemi, Huotilainen, 2013). Researchers pointed that high level of sensory – motor interactions especially in temporal and frontal neural systems can stimulate while listening or experiencing the music in normal participants (Zatorre, Chen and Penhune, 2007). The Timing (Tala ), Sequencing (Anukram) and Spatial arrangement and Movement (aandolan) are the three motor control functions related to basic expressive music controlled by sensory- motor neurons of the brain (Zatorre, Chen and Penhune, 2007). Basal ganglia, supplementary motor area, cerebellum and prefrontal cortex as well as dorsal premotor area were shown greater involvement in identification, perception, also expression of musical rhythms (Lewis *et al.*, 2004, Chen, Penhune, Zatorre, 2008). Enhanced neural mechanism in the pathways related to primary auditory cortex and temporal neo cortex (superior temporal gyrus) related music perception and production are still under investigation. Music affects and stimulates certain neural mechanism, which may aggregate positive and conclusive effect on human mind. A study further spots that primary auditory cortex –both anterior and posterior pathways stimulate while we perceive or produce tunes (Taraana) (Patterson *et al.*, 2002). Even we perceive certain tone (Sur) same neural mechanism activates.

The mirror neurons also have been proposed as a mechanism to perceive and integrate music related interactions (Molnar- Szakacs and Overy, 2006). This neural basis of musical experience involves not only high level of perception, but can evoke positive emotions as well as memories (Overy and Molnar-Szakacs, 2009).

Therapeutic application of music often involves activation of certain motor function, cognition, imagination, realization or covertly experiencing positive mood or ventilating distressed feelings. In other words, it can modify emotional response systems such as the subjective feeling system (consciousness), the autonomic nervous system, endocrine system as well as immune system. Let's note down the biological mechanisms of Pain.

### **Biology of Pain:**

Pain is a universal term that depicts unpleasant as well as distressing physical or emotional condition. Generally it may manifest as localized sensation of a particular body part or unpleasant quality that associated with behaviors by relieving or terminating the experience (Institute of medicine committee on pain, 1987). Human body has specific pain receptors. It covers almost body tissues and only responds when a detrimental stimulus activates. The unfavorable stimuli send out by specific nerves to spinal cord. Besides, sensitive nerve endings in the tissue and nerves connected to it acts as a primary afferent nociceptor. Through the process of transmission, neural signals pass through spinothalamic and spinoreticular tracts that end in the thalamus where the pain are processed and pushed to the cortex. In the descending pathway, especially nucleus raphe magnus and the pariaqueductal gray have an involvement in pain modulation (Steeds, 2015). Damage to the central nervous system, otherwise, somatosensory system disturbances too cause pain (Colloca *et al.*, 2017). This condition is called Neuropathic pain. Sustained muscle contractions, excessive activation of sympathetic nerve, sensitization of muscle tissue are some of the physiological processes that magnify or leads to chronic pain condition (Institute of medicine committee on pain, 1987).

### **Music Therapy in Pain Management:**

Music is a powerful way to express human emotions. It is one of the paramount device for self care. Only few researches evaluated and conceptualized the wide potential benefits of Indian Classical Music, especially in Pain Management. Muthuraman and Krishnakumar (2012) studied the effect of Anandhabhairavi on sixty patients who were to undergo surgery. Among thirty patients were selected at random and were received Anandhabhairavi along with 'treatment as usual', and other group received only usual treatment. Their post evaluation revealed that the group who received

Anandhabhairavi had a significant effect in post operative pain management which was evidenced by the reduction in analgesic requirement by 50%. Balan *et al.*, 2009 assessed efficacy of local anaesthetic cream, Indian classical instrumental music and placebo, in reducing pain due to venepuncture in children aged 5 to 12 years. In this prospective randomized clinical trial they found pain experienced during venepuncture significantly reduced by using Indian classical instrumental music. A pilot study by Krishna swami and Nair (2016) evaluated the effect of music therapy on pain and anxiety levels of cancer patients who are suffering from much pain. Statistically significant reduction observed in pain level in the cancer patients who attended music intervention than the controlled group. Jha *et al.* (2015) conducted a study to know the effect of Active Listening of Indian Classical Music during migraine episodes in patients with young (18 to 23 years old) female patients. Group No. 1 got standard treatment along with Music Therapy and the Group No.2 got only standard treatment. They observed that pain intensity, frequency of episode and duration of pain showed significant reduction in Group No.1 who received Music Therapy along with standard treatment. Their results express the potential role of Indian Classical Music as an adjuvant therapy for the management of Migraine. Viswanathan and Pinto (2015) intended to study the effect of Indian Classical Music based Chakra meditation on the symptoms of premenstrual syndrome. It comprised forty college students who were screened and qualified for the study were allotted to the intervention group and control group. Study found that results showed that there was significant reduction in all the post- test symptom clusters of the interventional group, compared with the pre- test symptoms. Xavier and Viswanath's (2016) quasi- experimental pre-post test control group study evaluated the effect of Indian Classical Music on Labor pain among in active labor admitted to a Tertiary care hospital in Kerala. The participants in the experimental group received Music Therapy for 30 minutes using headset after the pre-test. They have actively heard combinations of songs based on Ragas like Kapi, Hindolan, Mayamalavagoula, Yamuna Kalyani, Neelambari and Chalanatta. The result of the study concludes that Carnatic Music is much effective in reducing the pain and anxiety of women in labor without affecting the uterine contractions. Dietrich *et al.* (2015) tested the effect of Body Tambura (a stringed instrument commonly used for music therapies) in patients with

multiple pain complaints. The aim of this study was to know the perceived effects of a treatment with body Tambura, and the post test showed the pain intensity at baseline was significantly reduced. They concluded that it was very effective in pain reduction and the therapy was received and perceived well. Siritunga *et al.* (2013) single blind randomized clinical trial was conducted to see the effect of Indian Classical Music on patients with symptoms of stable Angina. The post intervention results showed severities of symptoms such as timing of the chest pain, chest pain during walking and climbing a staircase, the effect of chest pain in the day-to-day physical activities etc. significantly improved in patients who received 'treatment as usual' along with Music Therapy group relative to 'treatment as usual' group. Ragas such as Ahirbhairav, Darbari Kannada, Hindol, Jaijai Wanti, Nat Bhairavi, Yaman, Madhuvanti, Sohani, Gunakali are also found to be highly effective in reducing various physical pains.

### Conclusion:

Nowadays, Music Therapy grown to be an established health service similar to physiotherapy or occupational therapy to scientifically address physical, mental, cognitive and social functioning for all ages. 'It is the clinical and evidenced based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program' (American Music Therapy Association, 2011). This concise review provides evidence that traditional Indian Classical Music has unique healing effect through improving one's emotional and physical state more than relaxation. However, only few researchers systematically evaluated and conceptualized the wide potential benefits of Indian Classical Music.

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