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**Research Article**

# CONTINUOUS ULTRASOUND IMPROVES SYMPTOMES OF CHRONIC SINUSITIS

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**A R T I C L E I N F O**

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**A B S T R A C T**

**Background:** Ultrasound is used in musculoskeletal medicine. Animal studies have indicated that low-intensity ultrasound reduces inflammatory markers in the synovium via a reduction in inflammatory cell infiltrate .Ultrasound reduces joint pain in human osteoarthritis patients. Ultrasound treatment significantly decreased the number of inflammatory cells in the subepithelial and stromal layers.
**Methodology:** In this study we are recruited 20 subjects with chronic sinusitis after inclusion criteria were met. The subjects were divided into two groups by computer generated random number and quasi experimental study design was adopted for this study. Subjects are randomly selected and divided into 2 groups. Group A and Group B with 10 subjects each. Ultrasound is given over maxillary and frontal sinuses each separately.
**Result:** There is a statistically significant difference between post-test measures of 22-sinonasal outcome test ($p< 0.05$) among Group A patients who are treated with medications and Group B patients who were treated with medications and continuous ultrasound.
**Conclusion:** This study concluded that Continuous Ultrasound showed a significant improvement in reduction of symptoms in chronic sinusitis.



## INTRODUCTION

Chronic sinusitis is a common condition in which the cavities around nasal passages (sinuses) become inflamed and swollen for at least eight weeks, despite treatment attempts[1]. Also known as chronic rhinosinusitis, this condition interferes with drainage and causes mucus to build up. Sinusitis is an inflammation, or swelling, of the tissue lining the sinuses.

Normally, sinuses are filled with air, but when sinuses become blocked and filled with fluid, germs (bacteria, viruses, and fungi) can grow and cause an infection Conditions that can cause sinus blockage include the common cold, allergic rhinitis (swelling of the lining of the nose), nasal polyps (small growths in the lining of the nose), or a deviated septum (a shift in the nasal cavity).

As suggested by the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS 2007 and 2012), from an epidemiological standpoint, chronic rhinosinusitis (with or without nasal polyps) in adults is defined as presence of two or more symptoms one of which should be either nasal blockage, obstruction, congestion or nasal discharge (anterior/posterior nasal drip), facial pain or pressure reduction or loss of smell and symptoms must be present for more than 12 weeks. In a recent multicentre study performed as part of the Global Allergy and Asthma European Network project conducted study in 19 centers of 12 countries in Europe. The GA2LEN study concluded that the overall prevalencechronic rhinosinusitis of by EP3OS criteria was 10.9% of total population.

An estimated 134 million Indians suffer from chronic sinusitis. One in eight Indians suffer from chronic sinusitis caused by the inflammation of the nasal and throat lining, which results in the accumulation of mucus in the sinus cavity."The high pollution levels, congested living conditions and proximity to the sea may be a few reasons for the high prevalence in the city,"Besides pollution and congestion, sinusitis can be trigged by viral infections, which when untreated can lead to bacterial infections, allergies, and excessive moisture that can lead to the accumulation of fungus in the sinus cavities.

The current medical treatment of chronic rhinosinusitis focuses on the systemic and topical use of steroids and/or antibiotics. While steroids are effective in managing the underlying chronic inflammation, the underlying causes are not addressed. In the short term, antibiotics reduce bacterial diversity even more and allow colonization with microbes that are less susceptible to the prescribed antibiotics .Many bacteria residing on mucosal surfaces exist in a biofilm state, making them resistant to most antibiotics

Generally the global treatment of chronic sinusitis is Decongestant, antibiotics, antihistamines, tropicacosteriods and nasal wash. Ultrasound (US) is a form of Mechanical

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energy, Mechanical vibration at increasing frequencies also known as sound energy The normal human sound range is from 16Hz to something approaching 15-20,000 Hz (in children and young adults). Beyond this upper limit, the mechanical vibration is known as Ultrasound. The frequencies used in therapy are typically between 1.0 and 3.0 MHz (1MHz = 1 million cycles per second).

Therapeutic Ultrasound is produced by a transducer composed of a piezoelectric crystal, which converts electric energy into alternating compression and rarefaction of sound waves at a frequency greater than 20 kHz. The amplitude of the Ultrasound wave is proportional to the displacement of the Ultrasound transducer head during each half cycle. The amplitude represents the wave energy. The Ultrasound wave frequency corresponds to the number of times that the transducer tip is displaced per second.

The longitudinal mechanical waves generated are transmitted at right angles to the transducer head. This causes the underlying tissues to alternatively contract and expand. Ultrasound has three effects on tissues: thermal effects, cavitation and acoustic streaming. Thermal effects are minimal with pulsed as opposed to continuous ultrasound. Cavitation refers to the formation of microbubbles or cavities from dissolved gases, their growth and subsequent collapse in tissues and body fluids in extremely small time intervals (milliseconds). Stable cavitation, which is defined as the pulsation of cavitation bubbles over many acoustic pressure cycles without collapse, occurs at therapeutic ultrasound doses. Acoustic streaming refers to the small-scale eddying of fluids near vibrating structures, such as cell membranes and the surface of stable cavitation gas bubbles. This phenomenon produces shear stresses, which affect membrane diffusion and permeability.

Ultrasound is used in musculoskeletal medicine. Ultrasound reduces postoperative pain and swelling. Animal studies have indicated that low-intensity ultrasound reduces inflammatory markers in the synovium via a reduction in inflammatory cell infiltrate. Ultrasound reduces joint pain in human osteoarthritis patients. In surgically removed nasal polyps, Ultrasound treatment significantly decreased the number of inflammatory cells in the subepithelial and stromal layers. Hence this study aims to find the effect of continuous ultrasound on chronic sinusitis.

## METHODOLOGY

In this study we are recruited 20 subjects with chronic sinusitis after inclusion criteria were met. The subjects were divided into two groups by computer generated random number and quasi experimental study design was adopted for this study. A Pretest-Posttest design was chosen to determine the effect of continuous ultrasound on patients with chronic Rhinosinusitis. Ultrasound probe with head of geometric area 1.4cmis used. All potential subjects were screened by a Surgeon and Specialist in ENT, for inclusion in the trial. Only subjects who met the selection criteria were included in the study.

Subjects are randomly selected and divided into 2 groups. Group A and Group B with 10 subjects each. After obtaining the informed consent, Subjects were asked to lie in supine position. Cotton is placed on the eyes in order to protect the eyes during the procedure. Ultrasound is given over maxillary and frontal sinuses each separately.

***Ultrasound Parameters Used***

Mode : Continuous mode
Intensity : 1W/cm$^2$ for Maxillary sinus
0.5W/cm$^2$ for frontal sinus
Duration : 4 minutes for each frontal sinus
5 minutes for each maxillary sinus
Size of the head: Geometric area of 1.4 cm$^2$

## RESULTS

The Pre test mean value 22-sinonasal outcome test of group A is 57.9and the Post test value is 51.9.This table shows that , there is a statistically significant difference between pre-test and post-test measure of 22-sinonasal outcome test ($p< 0.05$) among Group A patients who were treated with only medications. The Pre test mean value 22-sinonasal outcome test of group B is 47.9 and the Post test value is 31.6. There is a statistically significant difference between pre-test and post-test measure of 22-sinonasal outcome test ($p< 0.05$) among Group B patients who were treated with medications and continuous ultrasound. The Post test mean value 22-sinonasal outcome test of group A is 51.90 and the Post test value of group B is 31.60. Which shows that there is a statistically significant difference between post-test measures of 22-sinonasal outcome test ($p< 0.05$) among Group A patients who are treated with medications and Group B patients who were treated with medications and continuous ultrasound.

**Table 1** Comparison of Pre Test and Post Test Values of 22- Sinonasal Outcome Test In Group A

| Variables | N | Pre-Test | | Post-Test | | T value | Significance |
|---|---|---|---|---|---|---|---|
| 22-Sinonasal outcome test | 15 | Mean 57.90 | SD 13.279 | Mean 51.90 | SD 10.482 | 3.025 | 0.014 |

**Table 2** Comparison of Pre Test and Post Test Values of 22- Sinonasal Outcome Test in Group B

| Variables | N | Pre-Test | | Post-Test | | T value | Significance |
|---|---|---|---|---|---|---|---|
| 22-Sinonasal outcome test | 10 | Mean 47.90 | SD 15.822 | Mean 31.60 | SD 8.959 | 5.739 | 0.001 |

**Table 3** Comparison of Post Test Values of Among Group AVs Group B

| | Groups | N | Mean | SD | Unpaired t Test | P Value |
|---|---|---|---|---|---|---|
| Post Test Score | Group A | 10 | 51.90 | 10.482 | 4.655 | 0.001 |
| | Group B | 10 | 31.60 | 8.959 | | |

## DISCUSSION

This study is to determine the effect of continuous ultrasound on chronic sinusitis, on reductions of its symptoms. The values of 22-Sinonasal outcome test were analysed for subjects in both Group A (Control group) and Group B (Experimental group). The result of this study shows a significant improvement in reduction of sinusitis symptoms in subjects who have undergone Therapeutic ultrasound on Continuous mode.

Although medications are commonly used as conservative treatment for chronic sinusitis. Very few studies have assessed the Effects of therapeutic ultrasound on chronic sinusitis.

Chronic sinusitis is a common condition in which the cavities around nasal passages (sinuses) become inflamed and swollen

for at least eight weeks, despite treatment attempts. Also known as chronic rhinosinusitis, this condition interferes with drainage and causes mucus to build up[2,6].

Sinusitis is a very common acute or chronic illness that affects a significant percentage of individuals[2]. Recently, therapeutic ultrasound was reported as a treatment for chronic sinusitis. The purpose of this study was to evaluate the effectiveness of low-intensity pulsed ultrasound (US) in chronic sinusitis using a pretest-posttest research design. This study revealed that there was reduction in sinusitis symptoms among group A patients ($p<0.05$) who were treated with medications.

The goals of pharmacotherapy are to eradicate the infection, to reduce morbidity, and to prevent complications. Agents used in the treatment of chronic sinusitis include antibiotics, decongestants, nasal saline sprays, mast cell stabilizers, and expectorant.So after administering the drug there was a reduction of symptoms. Similarly the post test values of 22-sinonasal outcome test shows significant improvement when compared to pre test values of Group B patients $p<0.05$.

This study highlights that continuous ultrasound therapy can improve symptoms of patients with chronic rhinosinusitis. This is consistent with the only previous report showing that for patients suffering from chronic rhinosinusitis, continuous ultrasound is an effective modality. Such improvements may result primarily from tissue heating. By using continuous ultrasound therapy, greater heating occurs in the tissue. Thus given the poor blood circulation in the sinuses, increased regional blood flow could be beneficial in reducing sinus inflammation and significant resolutions of symptoms. Another possible explanation for the improvements obtained with continuous ultrasound could be the mechanical effects. Both heating and mechanical effects of ultrasound are reported present during treatment.

The ostiometal complex has a key role in normal function. Blockage of sinus ostia due to inflammation of the muscosa causes retention of secretions within the sinus cavity which in turn may result in increased inflammation and bacterial infections. Mucosal damage disrupts normal ciliary function of the sinus. In order to promote recovery of the chronic rhinosinusitis drainage of sinus is essential, therefore we assume that the mechanical vibrations of the ultrasound waves might have helped drainage of the secretions.

In the study done by Brescovici *et al*, The direct effects of therapeutic ultrasound on biological tissues cannot be discarded, these effects may affect cell membrane permeability, enzyme activity and inflammation, and may facilitate local fibrinolysis[25]. Therapeutic Ultrasound has been shown to modify cellular and humoralsignaling factors, especially the bioavailability of nitrous oxide, thereby regulating interstitial permeability and tissue fluid balance this in turn results in decongestion of the nasopharyngeal mucosa, regression of interstitial oedema and of nasal obstruction/congestion in patients with chronic rhinosinusitis.

The results of this study shows that there is a statistically significant difference between post-test measures of 22-sinonasal outcome test ($p< 0.05$) among Group A patients who are treated with medications and Group B patients who were treated with medications and continuous ultrasound. Thus Ultrasound is found to have more benefits than the Medications over the symptoms of Sinusitis.Generally antibiotics is the first choice of treatment for sinusitis. First-line antibiotics for patients with chronic sinusitis include amoxicillin-clavulanate, second-generation cephalosporins, and erythromycin-sulfasoxazole. Beta-lactamase-mediated resistance to the early second-generation cephalosporins.

These drugs breakdown thick mucus blocking the cavity and reduce the inflammation by thinning down of the mucus. Since most of the drugs causes side effects like drug-resistant infection.Steroids can have side effects when taken in high doses and over a longer period of time. The nasal mucous membranes may become irritated or dry out, which can cause nosebleeds or temporary headaches, but the side effects are usually mild. So, therapeutic ultrasound being less harmful than the antibiotics. It can be used as a conservative treatment for chronic sinusitis.

This study in accordance with previous study done by Ansari *et al* shows there is a significant improvement in Group B patients treated with Continuous Ultrasound than Group A patients treated with Medications[20]. So this study recommends the use of Ultrasound in the management of Chronic Sinusitis.

## CONCLUSION

This study concluded that Continuous Ultrasound showed a significant improvement in reduction of symptoms in chronic sinusitis. So it can be used in the management of Sinusitis symptoms in patients with Chronic Sinusitis.

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