Music Therapy for Pain and Anxiety Management in Nasal Bone Fracture Reduction: Randomized Controlled Clinical Trial

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Abstract

Objective. To evaluate whether listening to music through binaural headphones contributes to the perception of pain and anxiety in patients undergoing closed nasal bone fracture reductions.

Study Design. Randomized controlled trial.

Subjects and Methods. We recruited patients from San Juan de Dios Hospital with displaced nasal fractures who required a reduction and assigned them to a control group or a music group. For both groups, a protocolized closed reduction of the nasal fracture with local anesthesia was performed. The music group heard music through headphones during the pre-, intra-, and postprocedural periods of the intervention. Physiological variables (blood pressure and heart rate) were measured. An anxiety survey (State-Trait Anxiety Inventory) and the visual analog scale for measuring pain were also applied.

Results. The music group exhibited significantly lower levels of systolic blood pressure ($P = .0001$), anxiety ($P < .0001$), and pain ($P = .0004$) than the control group.

Conclusion. Listening to music through headphones—a safe and low-cost intervention—appears to aid in pain and anxiety management associated with procedures that are usually uncomfortable, such as the reduction of nasal bone fractures with local anesthesia. We believe that this effect is achieved by the modulation of pain and anxiety on an emotional-affective dimension at a central level. Given its safety, feasibility, and low cost, music therapy should be considered a complementary treatment for pain and anxiety management for nasal fracture reduction performed with local anesthesia, as well as for other medical procedures of similar pain levels conducted without general anesthesia.

Keywords

nasal fracture, reduction, music, music therapy, pain, anxiety.
fracture needs to be reduced, which entails realigning bone fragments to their proper anatomic position. Usually, reduction is performed after 7 to 10 days,\(^2,3\) when initial edema has decreased but before bone consolidation is too advanced. Reduction can be conducted with general, local, or topical anesthesia,\(^3\) with no major differences in terms of functional or aesthetic results.\(^2,3\) However, the use of general anesthesia is associated with greater anesthetic risk, higher costs, longer hospital stay, and the use of more personnel, among other cost-effectiveness disadvantages.\(^3\) By contrast, the use of local anesthesia is associated with shorter hospital stay, less delay in treatment, and lower costs.\(^4\) Therefore, local anesthesia is often preferred for this procedure, particularly in centers with restricted resources, such as our own.

Nasal fracture reduction with local anesthesia is associated with different pain levels, usually measuring \(>5\) (out of 10) on the visual analog scale (VAS), and is therefore usually considered “quite painful” with a subsequent effect on quality of life associated with painful experiences.\(^5,5\) Additionally, studies show that increased levels of anxiety in patients before undergoing this surgical procedure\(^6,7\) produce cognitive and physical discomfort, a longer period of pain after the procedure, and an increase in the requirement of analgesics.\(^8\) Both pain and anxiety can generate demonstrable physiologic changes, such as an increase in blood pressure and heart rate.\(^9,10\)

Pain is considered to be influenced by physical, psychological, social, and cultural factors.\(^11,12\) A biopsychosocial model of pain describes it as a subjective multidimensional experience that is modulated by the perception of the individuals in different dimensions. Most interventions that are used in medicine are oriented toward the sensory-discriminative dimension to work on pain receptors (ie, anti-inflammatory drugs and analgesics), peripheral pain processing (ie, local anesthetics), and the central nervous system (ie, opioids).\(^11\)

To address other dimensions of pain, the act of hearing music during disagreeable procedures has been proposed as an adjuvant therapy to reduce pain and anxiety by means of modulating the emotional-affective and cognitive dimensions of pain perception at a central level. This is known as music therapy for pain management (while the concept of music therapy can be broad, this term is used in this article in this context). Music therapy has already been tested in different procedures, such as colposcopies, endoscopies, cystoscopies, breast biopsies, cardiac catheterization, ophthalmologic surgery, extracorporeal lithotripsy, abdominal or gynecological surgery, and orthopedic surgery, in the pre- and postoperative periods.\(^12\) It is believed that music has a lot of effects on central pain processing, particularly decreasing the activation of cortical networks involving attention and emotional responses toward pain signaling.\(^12,13\) Music generates a distraction from the aversive process, thereby changing the focus of attention from something negative to something pleasant.\(^14,15\) It also diminishes aversive emotional states, such as fear and anxious anticipation, which strongly affect both the experience of pain itself and the memory of perceived pain.\(^14,16,17\)

In practical terms, different protocols have been used for the utilization of music in medical procedures. Most of the reported studies have implemented music through headphones. In addition, music listening time has varied between 15 and 30 minutes in all phases of a medical procedure (pre- to postoperative).\(^12,13\)

Music selection is also a variable during these interventions. Some groups prepare standard song lists, and others let the patient to choose. Some weak evidence suggests that the benefit may be greater if the music is chosen by the patient.\(^11\) Other studies suggest that there is no difference if the music is chosen by the health team.\(^12\)

Rhythmic speed of the selected music seems to be a more relevant factor. Music between 60 and 80 beats per minute (ie, slow music, like most baroque pieces) was shown to achieve a greater relaxing and pain modulating effect for patients.\(^10,13\)

Considering all these facts, the aim of this study was to evaluate whether the use of a fixed list of rhythmically slow music delivered by over-the-ear binaural headphones during a nasal fracture reduction with local anesthesia decreases the perception of pain and anxiety associated with the procedure.

**Methods**

A randomized controlled trial was conducted where all patients were admitted to the ambulatory surgery unit of the hospital on the initial trauma for nasal fracture reduction at the Otorhinolaryngology Service of San Juan de Dios Hospital. The inclusion criteria for this study were patients aged \(\geq 18\) years, with 7 to 15 days between the initial trauma and the reduction procedure. The exclusion criteria were as follows: a history of hearing loss or use of hearing aids, a diagnosis of anxiety or mood disorder, being under treatment with anxiolytics or beta-blocker on the day of the intervention, existence of other concomitant fractures, and any contraindication for the use of local anesthetics.

Patients who met the inclusion criteria were invited to participate in the study. Written informed consent was obtained from all patients. This study was approved for implementation by the Ethics Committee for Research in Human Beings, Faculty of Medicine, University of Chile.

**Randomization**

Patients were randomized with a sequence of permuted blocks from a mobile application for smartphones (Randomizer) and designated to 1 of the 2 groups.

**Procedure**

Patients were called in after 7 to 14 days from the day of the initial trauma for nasal fracture reduction. They were admitted to the ambulatory surgery unit of the hospital on
the same day of the reduction (ambulatory procedure). The
reduction of nasal fracture was performed with the closed
technique and local anesthesia. To standardize the results,
the same anesthetic technique was applied: a bilateral endo-
nasal block of the infratrochlear and infraorbital nerves,
with no application of anesthesia into the nasal septum.
Two 2-mL ampoules of 2% lidocaine and 1:100,000 adrena-
line were applied with a Carpule syringe. After 5-minute
application of the anesthetic, the reduction of the frac-
ture was performed with a strictly closed technique. Afterward,
patients waited in the recovery room for a 1-hour clinical
observation before being discharged. They returned for a
follow-up in the otorhinolaryngology outpatient unit 7 days
after the procedure. Pain medication was standardized: para-
cetamol (acetaminophen), 500 mg every 8 hours, and keto-
profen, 100 mg every 12 hours for 7 days.

Music Implementation
A music list of rhythmically slow songs (60–80 beats per
minute) was constructed arbitrarily by the authors and is
freely available on Spotify (accessible by the QR code
displayed in Figure 1). All patients in the experimental
group heard this list by means of the same over-the-ear
Bluetooth headphones and set the music intensity them-
selves. Exposure time was 10 minutes prior to the inter-
vention, during the duration of the whole procedure, and 10
minutes postoperatively. The music did not interfere in any
way with the communication between the patient and the
medical team because a headphone could easily be removed
during the procedure to inform the patient of different steps
of the intervention.

Data
The following clinical data were recorded for all patients: the
date of the fracture and the date of the reduction procedure,
medical history, and use of drugs (with emphasis on antihy-
pertensives, beta-blockers, anxiolytics, chronic analgesics,
and antidepressants).

Physiologic variables, such as blood pressure and heart
rate, were measured at 4 assessment time points: (1) prior to
the intervention, (2) at the time of the administration of the
local anesthetic, (3) at the time of the reduction of the frac-
ture, and (4) 15 minutes after the procedure while in the
recovery room.

The “state” section of the State-Trait Anxiety Inventory
(STAI) was applied, consisting of 20 common phrases to
which the patient is asked to report their current state with a
score ranging from 0 to 3.18 The total score of each inventory
ranges from 0 to 60, and anxiety level is positively cor-
related with the score. Scores from 0 to 19 indicate a low
level of anxiety; 20 to 39, midlevel anxiety; 40 to 59, high-
level anxiety; and 60, panic status.

All patients completed the survey 3 times: before the
procedure, immediately after the procedure, and at 1-week
follow-up. For the final survey, patients were instructed to
report the anxiety remembered during the procedure.
Patients also responded to the VAS at each time point (0,
no pain; 10, worst pain), including a report of how much
pain they recall from the procedure.

At these 1-week follow-ups, 2 open general questions
were asked regarding the patient’s overall satisfaction with
the procedure. Additionally, a VAS was applied to describe
the patient’s experience as a whole (1, bad experience; 10,
good experience).

Sample Size Estimation
Considering the previous data of pain VAS variances from
similar studies12–17 and an alpha error of 5%, we estimated
that a sample size of 17 patients per group was necessary to
achieve a statistical power of 80%.

Statistical Analysis
Descriptive statistics were calculated for the variables,
including the medians and interquartile range (IQR). A gen-
eralized estimating equation (GEE) model was fitted to
assess differences between groups across time (across all
assessment time points). All analyses were made with Stata
15.1 (StataCorp, College Station, Texas). A P value <.05
was considered statistically significant, and all P values
were 2-sided.

Results
Of the 45 patients assessed for eligibility, 9 were excluded.
Therefore, 36 patients were recruited and randomized into 2
groups: 17 received the music intervention, and 19 did not
(Figure 2). There were 25 men and 11 women, with a
median age of 30.5 years (range, 18–60 years). No patient
was taking beta-blockers or anxiolytics. One patient had a
history of nasal fracture. The median time from initial face
trauma to conducting the reduction procedure was 10.7
days. In all patients, the procedure was conducted 7 to 15
days after the initial trauma. No adverse effects where
observed in either of the 2 groups. Table 1 presents further
details about patient characteristics.

Data in our outcome variables was not normally distribu-
ted (Shapiro-Wilk test, P < .0001); thus, nonparametric test
and statistics were preferred. There was no significant dif-
ference between groups when any variable was compared at

Figure 1. QR code leading to the Spotify music list used in this
study.
a specific time point (e.g., pain levels at the postreduction time point), but when variables were analyzed across time points, a statistical significance was indeed observed. Given the nonparametric nature of our data, GEE analysis was preferred over random effects models. GEE is a generalization of longitudinal linear models, which assumes unknown correlations between outcomes but, in this case, in function of time points of assessment.

**Physiologic Variables: Blood Pressure and Heart Rate**

**Figure 3** and **Table 2** show the behavior of systolic and diastolic blood pressure (SBP and DBP) across time—with measurements prior to any intervention, at the moment of local anesthesia application, at the moment of fracture reduction, and 15 minutes postoperatively. No significant difference in DBP was found between the music and control groups ($P = .1189$), and this parameter did not vary much across these 4 time points. However, for the control group, SBP increased when local anesthesia was applied, particularly at the moment of fracture reduction (rising as much as 20 mm Hg), and returned to near initial values 15 minutes after this procedure ended. By contrast, the music-exposed group maintained stable SBP during the whole experience. This difference was statistically significant under a GEE analysis, indicating that the music group has a lower SBP ($P < .0001$).

**Anxiety**

**Figure 5** and **Table 3** show anxiety levels in terms of STAI scores measured at 3 time points: prior to the procedure, after the finished procedure, and 1 week after the procedure. Anxiety scores ranged from 20 to 40 points, representing midanxiety levels. The behavior of this parameter differed importantly between groups. While both groups started at almost equal scores preoperatively, the control group exhibited increased anxiety scores after the procedure, whereas the music group maintained or even decreased its STAI scores below the initial values. When asked 1 week after the intervention how patients remembered the experience in terms of anxiety, they described the memory of their anxiety levels in similar terms to their immediate postoperative scores. On GEE analysis, with assessment of all 3 instances of the STAI application together, anxiety levels of the music group were significantly lower than those of the control group ($P < .0001$).

**Pain**

**Figure 6** and **Table 3** show a similar report for pain levels in terms of VAS scores, which were also measured prior to the procedure, after the finished procedure, and 1 week after the procedure. Both groups started with no or minimal pain (<1 point in VAS) and reported pain after the procedure. However, patients under music exposure scored their pain lower (median, 3 out of 10) than those in the control group (median, 6 out of 10) when measured immediately after the procedure was ended. This difference was significant ($P = .0004$) on the GEE analysis.
Subjectively, when patients in the music group were asked about hypothetically needing another nasal closed reduction with local anesthesia, 100% reported a preference for the music. Additionally, 94% of them felt that the music decreased negative symptoms. All patients in the study—those who received music therapy and those who did not—recommended the use of music in other surgical procedures with local anesthesia.

**Discussion**

To our knowledge, this is the first study to incorporate music therapy for modulating pain in nasal bone fracture reductions with local anesthesia. Our findings include objective and subjective benefits in the experimental group, which heard music during the procedure.

Because pain is a subjective experience, the best way to evaluate it is by asking the patient’s opinion. Although

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**Table 2. Blood Pressure and Heart Rate by Time Point.**

<table>
<thead>
<tr>
<th>Group</th>
<th>1: Basal</th>
<th>2: Local Anesthesia</th>
<th>3: Reduction</th>
<th>4: Postreduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBP</td>
<td>DBP</td>
<td>HR</td>
<td>SBP</td>
</tr>
<tr>
<td>Music</td>
<td>Median</td>
<td>124</td>
<td>70</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>IQR</td>
<td>10</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>225.4</td>
<td>151.2</td>
<td>123.9</td>
</tr>
<tr>
<td>Control</td>
<td>Median</td>
<td>125</td>
<td>72</td>
<td>70</td>
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<td></td>
<td>IQR</td>
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<tr>
<td></td>
<td>Variance</td>
<td>94.5</td>
<td>100.5</td>
<td>101.2</td>
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</table>

Abbreviations: DBP, diastolic blood pressure; HR, heart rate; IQR, interquartile range; SBP, systolic blood pressure.

**Figure 3.** Systolic and diastolic blood pressure of patients by group before, during, and after nasal fracture reduction (medians and interquartile ranges). Measurements were made at 4 time points: baseline, at local anesthesia application, at nasal bone fracture reduction, and 15 minutes after the procedure.

**Figure 4.** Heart rate of patients by group before, during, and after nasal fracture reduction (medians and interquartile ranges). Measurements were made at 4 time points: baseline, at local anesthesia application, at nasal bone fracture reduction, and 15 minutes after the procedure.
many scales are available to evaluate and quantify pain, the most used and widespread are the VASs. In this study, a lower VAS score was observed in the music group, and regardless of whether it was reflected in the physiologic variables, this alone can be interpreted as a better patient experience associated with this procedure. Moreover, anxiety has been linked not only to the experience of pain itself at the moment of a painful experience but also to the persistence and impact of the memory of pain in time. Experiences perceived as equally painful for different patients at a given point are remembered as less painful by those less anxious during the painful experience.15 Our findings suggest that all patients arrive to a procedure such as nasal reduction equally anxious but become less anxious over time if they hear music, even after experiencing the procedure. By contrast, the control group exhibited increased anxiety levels after the procedure. The reduction of anxiety under exposure to music during nasal reduction seems to diminish the pain experience. We hypothesize that this occurs by means of modulating the emotional-affective dimension of pain mechanisms at a central level.

These results, combined with the lower recalled VAS score 7 days postoperatively, seem enough to assess music therapy as useful in pain management. Moreover, our findings correlate this objective observation with an average lower SBP during the procedure as whole, thus reflecting the top-down effects of central modulation of music therapy in peripheral responses to pain and giving relevance to this technique far beyond the limits of purely psychological phenomena. On a patient-to-patient basis, we also observed a tendency of heart rate to be lower or remain stable in the music group as compared with the control group. However, changes in heart rate measurements were large, and we believe that a bigger sample size is needed to statistically confirm this tendency.

Altogether, the results showed lower SBP, less anxiety (measured by STAI), and less pain according to the VAS, showing a positive effect of the use of music for this procedure. Music therapy is a low-cost and simple intervention that is widely available, does not generate adverse effects, can improve the doctor-patient relationship and the experience associated with health care, and can have an important role in the management of anxiety and pain associated with this and other procedures of this specialty.

The general opinion of the patients who received music during this medical procedure was that they were satisfied with the intervention of music. Therefore, we think that it would be interesting to extend its use and incorporate it into our everyday practice of therapeutic options.

Figure 5. Anxiety of patients by group before, during, and after nasal fracture reduction (medians and interquartile ranges). Anxiety levels were measured by STAI score at 3 time points: preoperatively, immediately postoperatively, and at 1-week follow-up. STAI, State-Trait Anxiety Inventory.

Figure 6. Pain of patients by group before, during, and after nasal fracture reduction (medians and interquartile ranges). Pain levels were measured by VAS score at 3 time points: preoperatively, immediately postoperatively, and at 1-week follow-up. VAS, visual analog scale.

Table 3. Anxiety and Pain Levels by Time Point.

<table>
<thead>
<tr>
<th>Group</th>
<th>1: Prereduction</th>
<th>2: Postreduction</th>
<th>3: 1-wk Follow-up</th>
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<tr>
<td></td>
<td>Anxiety</td>
<td>Pain</td>
<td>Anxiety</td>
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<tr>
<td>Music</td>
<td>Median</td>
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<tr>
<td></td>
<td>IQR</td>
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<td>Variance</td>
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<td>2.3</td>
</tr>
</tbody>
</table>

Abbreviation: IQR, interquartile range.
therapy for pain management during nasal fracture reduction and potentially other surgical procedures performed with local anesthesia that are usually considered to be painful.

Author Contributions
Alvaro Ortega, authorship, collected data, designed study, analysis; Felipe Gauna, collected data, revised article; Daniel Munoz, statistical analysis, revised article, analysis; Gerardo Oberreuter, collected data, revised article; Hayo A. Breinbauer, analysis, revised article, designed study, statistical analysis; Loreto Carrasco, coauthor, revised article, analysis, corresponding author.

Disclosures
Competing interests: None.
Sponsorships: Spotify. The application was occupied by being the most famous and most widely used worldwide, but there are no conflicts or exclusivity with this application.
Funding source: None.

References