CE 1.5 ANCC Contact Hours

Impact of Music Therapy on Hospitalized Patients Post-Elective Orthopaedic Surgery

A Randomized Controlled Trial

Lisa M. Gallagher ▼ Vickie Gardner ▼ Debbie Bates ▼ Shelley Mason ▼ Jeanine Nemecek ▼ Jacquelyn Baker DiFiore ▼ James Bena ▼ Manshi Li ▼ Francois Bethoux

BACKGROUND: Music therapy (MT) research has demonstrated positive effects on fatigue, depressed mood, anxiety, and pain in perioperative care areas. However, there has been limited research on the effects of MT for surgical patients on orthopaedic units.

PURPOSE: The purpose of this study was to understand the impact of MT sessions on post-elective orthopaedic surgery patients' pain, mood, nausea, anxiety, use of narcotics and antiemetics, and length of stay.

METHODS: This was a randomized controlled study with an experimental arm (MT sessions) and a control arm (standard medical care). Patients received MT within 24 hours of admission to the unit, as well as every day of their stay. Same-day pre- and postdata were collected 30 minutes apart for both arms, including patient self-reported mood, pain, anxiety, and nausea. Use of medications and length of stay were gleaned from the electronic medical record.

RESULTS: Data were obtained for 163 patients, age 60.5 ± 11.1 years, 56% of whom were male. Joints targeted by surgeries were hips (54%), knees (42%), and shoulders (4%). There were significantly greater changes favoring the MT group on Day 1 (pain, anxiety, and mood), Day 2 (pain, anxiety, mood, and nausea), and Day 3 (pain, anxiety, and mood). Among participants with a pre–pain score of 2 or more on Day 1, a decrease of at least 2 points was noted in 36% of the MT group and 10% of the control group ($P < .001$). Overall, 73% of MT patients versus 41% of control patients reported improved pain ($P < .001$). No significant between-group differences in medications or length of stay were noted.

CONCLUSIONS: We observed greater same-day improvements of pain, emotional status, and nausea with MT sessions, compared to usual care, in patients hospitalized after elective orthopaedic surgeries. Effects on narcotic and antiemetic usage, as well as length of stay, were not observed. More research needs to be conducted to better understand the benefits of MT pre- and post-elective orthopaedic surgery.

Introduction

Total knee arthroplasties (TKAs) or total knee replacements (TKRs) are on the increase, with more than 600,000 surgeries completed annually in the United States (American Academy of Orthopaedic Surgeons, 2016). The number of hip arthroplasties (THA) has also increased, with more than 300,000 surgeries performed annually (Dotinga, 2015). These surgeries are generally performed for patients suffering from osteoarthritis, osteoarthrosis, osteonecrosis, or rheumatoid arthritis (Parker, 2011).

Patients recovering from TKAs, Birmingham hip resurfacing (BHR) or THA, and shoulder replacements or rotator cuff surgeries can be negatively impacted and their recovery complicated by experiencing severe pain, as well as a fear of anesthesia and discomfort (Antall & Kresevic, 2004; Eisenman & Cohen, 1995; Engwall & Duppils, 2009; Ignacio, Fai, Hui, Marie, & Goy, 2012;

Lisa M. Gallagher, MA, MT-BC, Research Program Manager, Arts and Medicine Institute, and Cleveland Clinic, Cleveland, OH.

Vickie Gardner, MSN, RN, Nurse Manager, Euclid Hospital, Cleveland, OH.

Debbie Bates, MMT, MT-BC, Music Therapy Manager, Arts and Medicine Institute, and Cleveland Clinic, Cleveland, OH.

Shelley Mason, CNP, RN, Certified Nurse Practitioner, Cleveland Clinic, Euclid Hospital, Cleveland, OH.

Jeanine Nemecek, MSN, RN, Director of Surgical Services, Euclid Hospital, Cleveland, OH.

Jacquelyn Baker DiFiore, RN, Cleveland Clinic, Euclid Hospital, Cleveland, OH; currently, Chief Nursing Officer, Ashtabula County Medical Center.

James Bena, MS, Lead Biostatistician, Cleveland Clinic, Quantitative Health Sciences, Cleveland, OH.

Manshi Li, MS, Statistical Programmer I, Cleveland Clinic, Quantitative Health Sciences, Cleveland, OH.

Francois Bethoux, MD, Cleveland Clinic Medical Director, Arts and Medicine Institute; Director, Mellen Center Rehabilitation Services, Neurological Institute.

The authors and planners do not declare any conflicts of interest, financial or otherwise.

DOI: 10.1097/NOR.0000000000000432

Lukas, 2004; Simcock et al., 2008). Attempting to decrease this pain can also help to decrease the patient's length of stay and recovery time while promoting patient satisfaction (Antall & Kresevic, 2004; Easter et al., 2010; Lin, 2011; Simcock et al., 2008). Utilizing a variety of nonpharmacologic techniques such as music, progressive muscle relaxation, massage, Reiki, art, imagery, meditation, relaxation therapy, and rhythmic breathing can be effective in addressing the physical and psychological aspects of pain and anxiety (Cepeda, Carr, Lau, & Alvarez, 2006; Engwall & Duppils, 2009; Evans, 2002; Horrigan, 2013; Lin, 2011; Parker, 2011; Pellino et al., 2005). These techniques are also beneficial in decreasing anxiety and pain, while increasing coping skills in patients post-TKA (Parker, 2011; Pellino et al., 2005).

Using music, guided imagery, and other complementary therapies may be helpful in not only decreasing pain but also decreasing the risk of sedation and confusion and other common side effects of pain medication, especially in elderly patients (Antall & Kresevic, 2004; Evans, 2002). They also may help to increase comfort and the ability to participate in physical therapy sooner, while decreasing the risk of complications, (Antall & Kresevic, 2004). Recorded music interventions have also been found to decrease respirations, heart rate, depression, anxiety, and the overall emotional burden in hospitalized patients (Phipps, Carroll, & Tsiantoulas, 2010). Using music in a therapeutic manner can be especially helpful in decreasing the anxiety and stress associated with being hospitalized, and it has been suggested that it is also a cost-effective, minimally invasive intervention for addressing pain, anxiety, and coping (Easter et al., 2010; Eckhouse et al., 2014; Gallagher, Lagman, Walsh, Davis, & Legrand, 2006; Lukas, 2004).

The use of music prior to various outpatient surgeries improved vital signs and decreased preoperative anxiety (Ni, Tsai, Lee, Kao, & Chen, 2011). Playing music during and after surgery has resulted in decreased pain, anxiety, and stress for patients, as well as the use of sedation and analgesia during surgery and narcotics after surgery (Eisenman & Cohen, 1995; Engwall & Duppils, 2009; Evans, 2002; Nilsson, Rawal, & Unosson, 2003; Simcock et al., 2008). The effect of music was positive when utilizing both general anesthesia and regional anesthesia (Eisenman & Cohen, 1995; Nilsson et al., 2003; Simcock et al., 2008). Music has also been found to be effective during and after surgery, as well as prior to ambulation in decreasing postsurgical pain (Good et al., 2001; Nilsson, Rawal, & Unosson, 2003).

Common music therapy (MT) interventions/goals to address pre- and postoperative anxiety and pain have included active music making and listening to live or recorded music (Bradt, Dileo, & Shim, 2013; MacDonald et al., 2003). Several studies have utilized patient-preferred music and found it to be effective, while other studies have utilized researcher-chosen music (Bradt et al., 2013; Eisenman & Cohen, 1995; Lin, 2011; MacDonald et al., 2003).

Simcock et al. (2008) asked patients scheduled for TKA or THA to choose three CDs that would be played throughout their surgeries. Results demonstrated decreased anxiety and pain when music was used during and after surgery, as well as decreased physiologic stress and stress hormones (Simcock et al., 2008). Music-focused relaxation has also been found to be helpful in decreasing the anxiety of patients receiving orthopaedic care (Eckhouse et al., 2014). Allred, Byers, and Sole (2010) investigated the use of music listening before and after the first ambulation post-TKA. They found statistically significant lower anxiety and pain over time and suggested that listening to music could help limit the adverse effects of opioid medications (Allred et al., 2010). Lin (2011) found that relaxation therapy was helpful in decreasing pain severity while promoting sleep and relaxation in patients who received total joint replacements. Listening to music before, during, and after orthopaedic surgery resulted in improved anxiety and pain management (Lukas, 2004).

While several studies have been published regarding the use of music, there are limited evidence-based studies of the utilization of MT with patients post-elective orthopaedic surgery. MT is the utilization of music interventions by a board-certified music therapist within a therapeutic relationship with a patient to accomplish individualized and specific goals (American Music Therapy Association, 2005). The main goal of this study was to understand the impact of MT sessions on patients' experiences post-elective orthopaedic surgery compared to usual care alone. It was hypothesized that MT would have a positive effect on patients' self-reported scores of pain, anxiety, mood, and nausea. It was also hypothesized that participation in MT would have a positive effect on length of stay and the use of narcotics and antiemetics.

Methods

Subjects

This study was approved, and a waiver of written informed consent was granted by the institutional review board at The Cleveland Clinic. All procedures followed were in accordance with the Helsinki Declaration of 1964 and its later amendments or comparable ethical standards (World Medical Association, 2016). Patients who were to receive elective orthopaedic surgery were recruited by the Pre-Admission Testing nurses (PATs) when they arrived at the hospital for their preadmission testing. Only those patients who were to be admitted to the orthopaedic unit at Euclid Hospital postsurgery were eligible for the study. Subjects also had to be at least 18 years old; cognitively able to consent to participate; and able to speak, read, and write English. Patients who ended up sharing a semiprivate room with another patient already participating in the study were excluded from participation. Nonelective orthopaedic surgical patients, those who did not have their testing done at Euclid Hospital, those whose surgeries were moved to another hospital, and patients on isolation or contact precautions were also excluded.

Informed consent was obtained by the PATs during preadmission testing, or by the Surgery Center nurse or a Research Assistant on the day of surgery (for those patients who were not ready to consent during preadmission testing). Patients who agreed to participate were randomly assigned to either the MT (experimental) arm or the control arm of the study through the use of a computerized block randomization table. Block randomization was utilized to maintain balance between the two arms in the study, and it was based on the subject's data and time of consent. Allocation concealment was utilized, and the information was kept on a secure password protected drive. Only the PI on the study knew the order of randomization. Patients did not know to which group they had been assigned until after their surgeries, and study staff did not know until they received the schedule at the beginning of each week.

Once the patients reached the 27-bed unit, after surgery it was determined whether they were eligible to remain in the study. Patients participating in the study were assigned a private room whenever possible, or they were the only patients enrolled in the study in a semiprivate room. If the patient was assigned to the room of another patient who was already participating in the study, the newly arrived patient was excluded. If two patients from the MT arm were moved into a semiprivate room, the patient who was involved in the study the least amount of time was excluded unless the music therapist was able to see one patient while the other was out of the room and vice versa.

Sessions/Procedures

Patients enrolled in the experimental arm of the study received an MT session every day of their hospitalization, with the first session occurring within the first 24 hours of admission to the orthopaedic unit or approved overflow unit. This was based on the time of the nurse's first note when admitting the patient to the unit. If the first session did not occur within this timeframe, the patient was removed from the study. If a patient declined to participate in an MT session, he or she was offered a session at another time that day. If a patient declined twice in 1 day, the music therapist returned the following day. This process continued throughout the patient's admission. The total number of MT sessions during each patient's hospitalization was recorded.

The MT sessions involved assessment and MT interventions. The board-certified music therapists collaborated with the patients to determine individualized goals for the session and also provided individualized interventions to address these goals. The patient had input regarding the types of interventions he or she wished to engage in during the session. MT methods used were receptive/listening, re-creative, composition, or improvization (Bruscia, 2014). These included such things as the patient choosing songs and then listening to live music performed by the music therapist; or the patient engaging in the session by playing or improvising on instruments, singing, discussing song lyrics, reminiscing/sharing memories, and/or participating in music-assisted relaxation techniques such as breathing, progressive muscle relaxation, and imagery. Multiple goals were addressed in some sessions, and multiple interventions could also be utilized within one session. MT sessions lasted approximately 30 minutes.

Patients in the control arm did not receive MT sessions; however, they were provided with usual care post-elective orthopaedic surgery. A research assistant or an investigator on the study, other than the music therapists who provided MT sessions, visited these patients daily and asked them to complete the mood, pain, nausea, and anxiety instruments. The first set of data was collected, and then the second set of data was collected 30 minutes later (the same length of time as a typical MT session).

Data Collected

Patient information included age, gender, race/ethnicity, diagnosis, type of surgery, comorbidities, and length of stay. Symptom severity measures were administered before and after MT interventions (pain, anxiety, nausea, and mood) by a research assistant or an investigator on the study, other than the music therapists who provided the MT sessions, via the use of an iPad. These individuals were not blinded to the intervention. The iPad was connected with the Cleveland Clinic secured network and the data were directly uploaded into a REDCap database. REDCap is a secure, web application designed to support data capture for research studies, providing user-friendly web-based case report forms, real-time data entry validation (e.g., for data types and range checks), audit trails, and a de-identified data export mechanism to common statistical packages such SPSS, SAS, Stata, and R/S-Plus (Harris et al., 2009). The system is protected behind a log-in and Secure Sockets Layer (SSL) encryption.

Four patient-reported variables were scored before and after the 30-minute time period, three on a 0-10 point numeric rating scale (pain, anxiety, and nausea), and mood on a 0-4 point scale based on the Rogers Happy/Sad Faces Assessment Tool (Rogers, 1981). For all of these scales, higher scores represent worse results.

Data collected from the inpatient pharmacy included for narcotic and antiemetic medications, name and dosage of medications used during hospitalization, the number of tablets and doses given, and whether or not the patient was on the medications prior to hospitalization. These data were matched with the data in the electronic medical record as to the date, time, and dosages of narcotics and antiemetics given throughout the patient's hospitalization. All medication-related data were entered into the REDCap database

Statistical Considerations

A G*Power analysis for medium effect size indicated that 79 patients were needed in each arm to achieve the needed power. Allowing for attrition of approximately 20% in each arm, it was estimated that a sample of 200 would allow for sufficient power for statistical analysis. Therefore, 200 patients were recruited for the study.

Statistical Methods

Categorical factors were summarized using frequencies and percentages, while continuous measures were described using means and standard deviations for normally distributed variables and medians and quartiles for nonnormally distributed measures. For comparisons of patient characteristics, two-sample *t* tests, Pearson's chi-square tests, and Fisher's exact tests were used as appropriate. For comparisons of groups on outcomes within day, similar tests were used. To compare groups on patient-level outcomes including medication use and length of stay, linear models were fit. To compare groups on changes in scores across days, linear mixed effect models were fit. An interaction between day and group was introduced, but was not significant in any of the models, and was removed. Mean differences between groups across days with 95% confidence intervals were calculated with as were mean differences. For the success measure of improvement or maintenance of a score of 0, logistic regression models with generalized estimating equations were fit. As above, an interaction between group and day was considered, but found to be non-significant and removed. Results from the logistic regression model are presented as predicted probabilities, and comparisons between groups are presented as odds ratios with 95% confidence intervals. Analyses were performed using SAS software (version 9.4; SAS, Cary, NC).

Results

Patient Sample

A total of 292 patients were approached, 200 were enrolled in the study, 91 did not consent to participate, and one was ineligible. Reasons for exclusion are listed in Figure 1. Data were available for 164 patients. One patient who failed to complete any information for the study was excluded, leaving 163 patients: 79 in the control group and 84 in the experimental group (see Figure 1).

Table 1 shows descriptive summaries of patient demographic factors. No significant between-group differences at baseline were observed. For sake of ease, type of surgery was listed as knees, hips, or shoulders (see Table 1). However, there were different types of surgeries performed for each of these. For instance, knees included TKAs, TKRs, partial knee replacements, and conversion of unilateral to TKA. Hips included BHR, arthroscopy, hip revisions, total hip replacements, and a left revision of the femoral component-Birmingham. Shoulders included total shoulder arthroscopies and total shoulder replacements.

Music Therapy Sessions

Twenty-three different goals were addressed during the MT sessions, with multiple goals often addressed during the same session. Goals were individualized for each patient based on patients' needs, with the most frequently used goals addressing relaxation (27%), pain (22%), self/emotional expression (19%), anxiety (9%), support (4%), mood (4%), nausea (3%), coping (2%), reminiscence/memory sharing (2%), and spirituality (1%). All remaining goals were addressed in less than 1% of sessions. Eighteen different interventions were used during the sessions, with multiple interventions used in the majority.

The most frequent interventions utilized were music listening—live or recorded (30%); support/validation (24%); song choices (13%); instrument playing and/or instrumental improvization (7%); lyric and/or music discussion/analysis (7%), singing (6%); music-assisted relaxation—rhythmic breathing, progressive muscle relaxation and/or imagery (5%), and reminiscence/memory

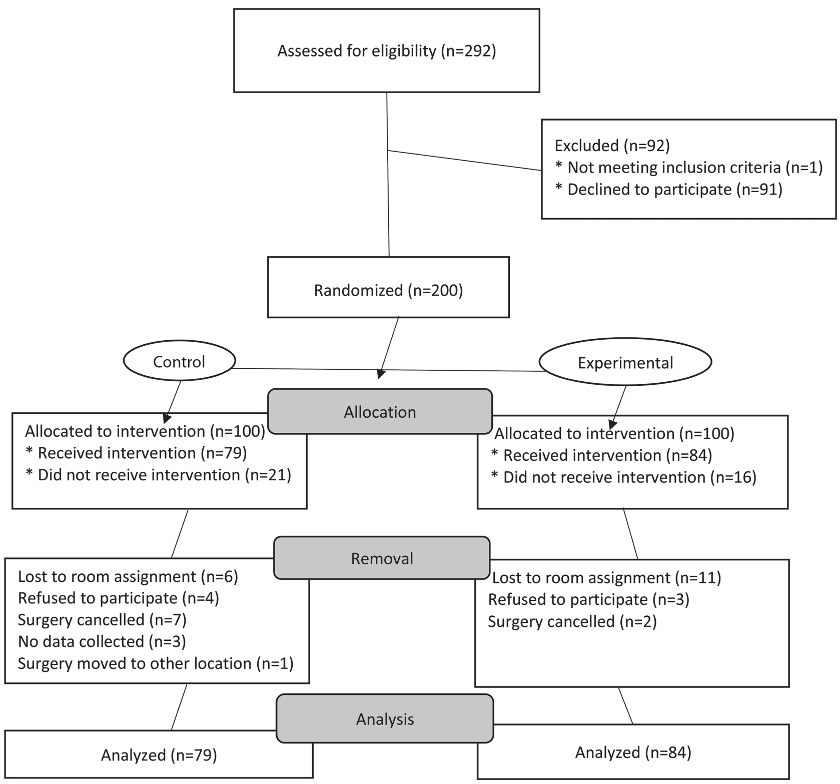

Figure 1. Enrollment flow diagram.

TABLE 1. PATIENT DEMOGRAPHICS

Factor	Total (*N* = 163)	Control Group (*n* = 79)	Experimental Group (*n* = 84)
Patient age	60.5 ± 11.1	59.9 ± 11.6	61.1 ± 10.6
Gender			
Male	92 (56.4)	44 (55.7)	48 (57.1)
Female	71 (43.6)	35 (44.3)	36 (42.9)
Race			
Missing	10 (6.1)	4 (5.1)	6 (7.1)
Hispanic	1 (0.61)	1 (1.3)	0 (0.0)
Non-Hispanic	152 (93.3)	74 (93.7)	78 (92.9)
Primary diagnosis			
Osteoarthritis	83 (50.9)	37 (46.8)	46 (54.8)
Osteoarthrosis	67 (41.1)	34 (43.0)	33 (39.3)
Avascular necrosis	2 (1.2)	2 (2.5)	0 (0.0)
Mechanical complication	4 (2.5)	2 (2.5)	2 (2.4)
Arthritis	7 (4.3)	4 (5.1)	3 (3.6)
Type of surgery			
Knee	69 (42.3)	34 (43.0)	35 (41.7)
Hip	88 (54.0)	41 (51.9)	47 (56.0)
Shoulder	6 (3.7)	4 (5.1)	2 (2.4)

Note. Values are presented as mean ± SD or *N* (column %).

TABLE 2. FOLLOW-UP SUMMARY STATISTICS

Factor	Total (*N* = 163)	Control Group (*n* = 79)	Experimental Group (*n* = 84)
Day 1	163 (100)	79 (100)	84 (100)
Day 2	123 (75.5)	61 (77.2)	62 (73.8)
Day 3	70 (42.9)	37 (46.8)	33 (39.3)

Note. Values are presented as *N* (column %).

sharing (4%). All other interventions were utilized in 1% of sessions or less. When looking at the interventions in terms of Bruscia's four methods, they break down as follows: receptive/listening (61%), recreative (12%), improvisation (1%), and composition (0%). In addition, 26% of interventions included, for example, verbal processing, therapeutic use of self, support and validation, and affirmation.

Following evaluation of length of stay, adequate data existed only through day 3, so later follow-up measurements were truncated at this point. Minimal clinically important differences (MCIDs) of at least 2 points on pain, nausea, and anxiety, and at least 1 in mood were calculated among patients with baseline levels that were at least as large as the MCID. Thus, for example, patients with a pain score of 1 pretherapy were not included in the MCID calculation because a 2-point decrease was not possible. Success was also evaluated using improvement from baseline or maintaining a score of 0 as a success.

OUTCOMES

Table 2 shows the distribution of follow-up days by group. By Day 3, about 60% of patients were lost to follow-up due to discharge. Table 3 shows summaries of patient-level outcomes. Summaries of total antiemetic use and length of stay were very similar across groups. For total narcotic use, although median levels were higher in the experimental group, quartiles were quite similar across groups.

Tables 4A, 4B, and 4C show the outcomes by day. At Day 1, significantly better outcomes were seen in pain, anxiety, and mood among the experimental group compared with the control group. This was a consistent finding based on change scores, percentage of patients reaching MCID, or percentage of patients exhibiting improvement. At Day 2, all measures showed significantly greater changes in the experimental group, while at Day 3, all measures except nausea saw greater improvements in the experimental group.

Table 5 shows the comparisons of raw survey score changes pre- to post across all days. Those in the control group saw on average a 0.25 point improvement in their pain score, while those in the experimental group had their pain improve on average by more than 1.25 points (mean difference 1.03, $p < .001$). Anxiety and mood saw similar mean changes in terms of significance, while the change in nausea was smaller, yet still significant at the 0.05 level ($p = .044$). Analysis of the improvement score for each survey yielded similar findings. For pain, 41% of control patients reported an improvement in pain pre- to posttherapy, as compared with 73% of experimental patients. This corresponds to an odds ratio of 3.8 ($p < .001$). As above, significant differences were also seen in pain, anxiety, and nausea. The patient-level outcomes for medication and length of stay were also identified, but no significant differences between groups were observed.

Discussion

MT was found to consistently produce immediate improvement of pain and anxiety, and in some cases nausea, at a statistically significant level compared to usual care, during an inpatient stay after elective orthopaedic surgery. The efficacy of MT was demonstrated both over the entire intervention period and on each of the 3 days included in the analysis. Demonstrating significant changes in pain on Days 1 and 2 supports the findings of Ignacio et al. (2012), who also found significant changes in elective orthopaedic surgical patients on Days 1 and 2. They also found a decrease in anxiety on Day 2, which is consistent with our findings. Ignacio et al. (2012) also did not find any significant differences regarding the use of analgesic drugs. One difference here is that their patients received patient-controlled analgesia (PCA) after surgery, whereas our patients received either oral or injected medications, not PCA. The limitations, however, of Ignacio's study were the small sample size of 21

Table 3. Summary Statistics of Admission Outcomes

Factor	Total (*N* = 163)	Control Group (*n* = 79)	Experimental Group (*n* = 84)
Total dose narcotics	140.0 [75.0, 225.0]	127.5 [75.0, 225.0]	150.0 [77.5, 225.0]
Total dose antiemetics	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]	0.00 [0.00, 1.00]
Length of stay	2.0 [2.0, 3.0]	2.0 [2.0, 3.0]	2.0 [2.0, 3.0]

Note. Values are presented as median [P25, P75].

patients, as well as a lack of description of the music intervention. Allred et al. (2010) found that in patients having a TKA, a statistically significant decrease was noted in anxiety and pain as compared to the control group who quietly rested. This too is consistent with our findings. Neither of these studies evaluated nausea.

It was noted by Dotinga (2015) that between 2000 and 2010 the length of stay for hip replacements decreased from almost 5 days to slightly under 4 days. This compares with the average length of stay of 3 days in our study. This short duration of hospitalization could explain why we did not see any reduction in length of stay with MT.

Many of the published studies on the effects of music perioperatively involved small sample sizes (Antall & Kresevic, 2004; Eisenman & Cohen, 1995; Ignacio et al., 2012; Simcock et al., 2008); therefore, our finding on a much larger sample is a significant contribution to the literature. It is also important to note that many of the previous studies pre-, during, and/or postsurgery focused on only one intervention or utilized recorded music and/or recorded music-focused relaxation, instead of live MT interventions (Allred et al., 2010; Antall & Kresevic, 2004; Eckhouse et al., 2014; Eisenman & Cohen, 1995; Good et al., 2001; Lin, 2011; Lukas, 2004;

Table 4a. Summary Statistics, Day 1 Outcomes

Factor[a]	Total (*N* = 163)	Control Group (*n* = 79)	Experimental Group (*n* = 84)	*p*
Pretherapy pain	3.5 ± 2.3	3.3 ± 2.3	3.6 ± 2.3	.43[b]
Pretherapy anxiety	1.5 ± 2.0	1.5 ± 2.0	1.5 ± 2.0	.99[b]
Pretherapy nausea	0.69 ± 1.8	0.60 ± 1.6	0.77 ± 1.9	.55[b]
Pretherapy mood	1.2 ± 0.85	1.1 ± 0.92	1.2 ± 0.78	.53[b]
Posttherapy pain	2.9 ± 2.3	3.3 ± 2.2	2.6 ± 2.3	.065[b]
Posttherapy anxiety	0.71 ± 1.3	1.01 ± 1.6	0.43 ± 0.95	***.005***[b]
Posttherapy nausea	0.40 ± 1.2	0.40 ± 1.2	0.40 ± 1.2	.99[b]
Posttherapy mood	0.69 ± 0.84	1.04 ± 0.86	0.37 ± 0.67	***<.001***[b]
Change pain	0.54 ± 1.6	0.05 ± 1.7	1.00 ± 1.4	***<.001***[b]
Change anxiety	0.77 ± 1.4	0.46 ± 1.2	1.05 ± 1.6	***.009***[b]
Change nausea	0.29 ± 1.3	0.21 ± 1.2	0.37 ± 1.5	.43[b]
Change mood	0.49 ± 0.84	0.10 ± 0.57	0.86 ± 0.88	***<.001***[b]
MCID: Pain	30 (23.8)	6 (10.0)	24 (36.4)	***<.001***[c]
MCID: Anxiety	33 (55.0)	10 (33.3)	23 (76.7)	***<.001***[c]
MCID: Nausea	11 (47.8)	3 (30.0)	8 (61.5)	.21[d]
MCID: Mood	70 (55.1)	12 (21.4)	58 (81.7)	***<.001***[c]
Improvement: Pain	89 (54.9)	28 (35.9)	61 (72.6)	***<.001***[c]
Improvement: Anxiety	143 (88.3)	62 (79.5)	81 (96.4)	***.001***[d]
Improvement: Nausea	150 (93.2)	70 (89.7)	80 (96.4)	.12[c]
Improvement: Mood	103 (63.6)	32 (41.0)	71 (84.5)	***<.001***[c]

Note. Values presented as mean ± SD or *N* (column %). The values in bold italic represent values that are statistically significant. MCID = minimal clinically important difference.
[a]Data are not available for all subjects.
[b]***t***-test.
[c]Pearson's chi-square test.
[d]Fisher's Exact test.

Table 4b. Summary Statistics, Day 2 Outcomes

Factor[a]	Total (N = 163)	Control Group (n = 79)	Experimental Group (n = 84)	p
Pretherapy pain	4.2 ± 2.4	4.0 ± 2.3	4.3 ± 2.5	.40[b]
Pretherapy anxiety	1.2 ± 1.9	1.2 ± 2.1	1.2 ± 1.8	.98[b]
Pretherapy nausea	0.82 ± 1.9	0.75 ± 1.7	0.89 ± 2.1	.70[b]
Pretherapy mood	1.2 ± 1.00	0.95 ± 0.85	1.4 ± 1.08	***.011***[b]
Posttherapy pain	3.1 ± 2.4	3.5 ± 2.4	2.8 ± 2.4	.14[b]
Posttherapy anxiety	0.84 ± 1.6	1.2 ± 1.8	0.52 ± 1.2	***.019***[b]
Posttherapy nausea	0.44 ± 1.5	0.72 ± 2.1	0.16 ± 0.61	***.046***[b]
Posttherapy mood	0.74 ± 0.84	0.95 ± 0.79	0.53 ± 0.84	***.006***[b]
Change pain	1.03 ± 1.6	0.52 ± 1.5	1.5 ± 1.6	***<.001***[b]
Change anxiety	0.39 ± 1.6	0.05 ± 1.6	0.73 ± 1.5	***.016***[b]
Change nausea	0.38 ± 1.5	0.03 ± 0.97	0.72 ± 1.8	***.010***[b]
Change mood	0.44 ± 0.77	0.00 ± 0.37	0.87 ± 0.82	***<.001***[b]
MCID: Pain	43 (41.0)	10 (19.6)	33 (61.1)	***<.001***[c]
MCID: Anxiety	17 (44.7)	5 (27.8)	12 (60.0)	.058[c]
MCID: Nausea	15 (68.2)	3 (30.0)	12 (100.0)	***<.001***[d]
MCID: Mood	45 (51.1)	4 (10.0)	41 (85.4)	***<.001***[d]
Improvement: Pain	77 (63.1)	31 (51.7)	46 (74.2)	***.010***[c]
Improvement: Anxiety	96 (78.7)	38 (63.3)	58 (93.5)	***<.001***[d]
Improvement: Nausea	109 (90.1)	50 (83.3)	59 (96.7)	***.016***[d]
Improvement: Mood	75 (61.5)	21 (35.0)	54 (87.1)	***<.001***[c]

Note. Values are presented as mean ± SD or N (column %). The values in bold italic represent values that are statistically significant.
MCID = minimal clinically important difference.
[a]Data are not available for all subjects.
[b]*t*-test.
[c]Pearson's chi-square test.
[d]Fisher's Exact test.

Ni et al., 2011; Ottaviani, Jean-Luc, Thomas & Pascal et al., 2012; Parker, 2011; Pellino et al., 2005; Simcock et al., 2008). Although the utilization of recorded music showed positive results, the use of live MT interventions also demonstrated positive results. We purposefully allowed the music therapists to use a variety of MT interventions to better reflect standard MT clinical practice. The sessions were therefore individualized, and promoted patient input, and this approach yielded significant results. These interventions also have the potential to affect more than pain, anxiety, and nausea. Although it was not a measure in our study, in some sessions patients expressed feeling depressed at the beginning of the session but stated that they had less depression at the end of the session. Therefore, MT has the potential to address a wide variety of patient needs.

One strength of this study was the use of a randomized, controlled, trial methodology. Another strength was the collection of pre- and post scores by a research assistant who was not involved with the treatment. The music therapists were blinded to the pre- and posttherapy scores. Although this makes the study methodologically stronger, it does not follow usual clinical practice. When conducting MT sessions in the clinical setting, the music therapist is usually not blind to the patient self-reports of symptom severity. This helps in identifying goals and implementing interventions. Being aware of postsession symptom severity may help adjust the treatment plan for future visits. The blinding of the music therapists may explain why pain was addressed as a goal in only 22% of sessions, anxiety in 9%, and mood in 4%.

Many of the patients expressed appreciation for the MT sessions. One patient, in particular, who was waiting for transport to come for her discharge, wanted MT one more time before she left. She told the music therapist that she attributed her ability to stop pain medication within 48 hours of surgery to holistic healing practices and the supportive MT sessions she had received. Even though some patients were dissatisfied with their group assignment, none withdrew from the study for this reason. No safety issues were identified during the study.

One limitation to the study is that the patients were not blinded to intervention as this was not possible. The research assistants who collected the pre- and postsession data also were not blinded to group assignment. This was also not feasible as, in the case of the experimental group, they had to let the music therapist know the patient was ready to be seen, and at the end of the

Table 4c. Summary Statistics, Day 3 Outcomes

Factor[a]	Total (N = 163)	Control Group (n = 79)	Experimental Group (n = 84)	p
Pretherapy pain	3.4 ± 2.4	2.9 ± 2.4	4.0 ± 2.4	.060[b]
Pretherapy anxiety	1.6 ± 2.3	1.3 ± 2.1	1.9 ± 2.4	.24[b]
Pretherapy nausea	0.56 ± 1.3	0.64 ± 1.4	0.47 ± 1.2	.60[b]
Pretherapy mood	1.09 ± 0.93	1.06 ± 0.92	1.1 ± 0.94	.76[b]
Posttherapy pain	2.7 ± 2.3	2.8 ± 2.3	2.5 ± 2.4	.63[b]
Posttherapy anxiety	0.93 ± 1.8	1.3 ± 2.1	0.50 ± 1.2	.063[b]
Posttherapy nausea	0.250 ± 0.78	0.28 ± 0.66	0.22 ± 0.91	.76[b]
Posttherapy mood	0.65 ± 0.84	0.94 ± 0.95	0.31 ± 0.54	***.002***[b]
Change pain	0.74 ± 1.6	0.08 ± 1.1	1.5 ± 1.8	<***.001***[b]
Change anxiety	0.66 ± 1.7	-0.03 ± 0.91	1.4 ± 2.0	<***.001***[b]
Change nausea	0.31 ± 1.2	0.36 ± 1.4	0.36 ± 1.4	.70[b]
Change mood	0.44 ± 0.80	0.11 ± 0.62	0.81 ± 0.82	<***.001***[b]
MCID: Pain	15 (30.0)	3 (13.0)	12 (44.4)	***.029***[c]
MCID: Anxiety	13 (48.1)	1 (7.1)	12 (92.3)	<***.001***[c]
MCID: Nausea	5 (55.6)	3 (50.0)	2 (66.7)	.99[c]
MCID: Mood	25 (53.2)	6 (25.0)	19 (82.6)	<***.001***[c]
Improvement: Pain	36 (52.9)	14 (38.9)	22(68.8)	***.014***[d]
Improvement: Anxiety	54 (79.4)	25 (69.4)	29(90.6)	***.039***[c]
Improvement: Nausea	60 (88.2)	31 (86.1)	29(90.6)	.71[c]
Improvement: Mood	45 (66.2)	17 (47.2)	28(87.5)	<***.001***[c]

Note. Values are presented as mean ± SD or *N* (column %). The values in bold italic represent values that are statistically significant. MCID = minimal clinically important difference.
[a]Data are not available for all subjects.
[b]*t* test.
[c]Fisher's Exact test.
[d]Pearson's chi-square test.

Table 5. Comparisons Survey Scores and Patient-Level Outcomes Overall

Cohort	Control: Mean (95% CI)	Experimental: Mean (95% CI)	Difference: Mean (95% CI)	p
Pain change	0.25 (−0.02, 0.52)	1.28 (1.02, 1.55)	1.03 (0.67, 1.40)	<***.001***[a]
Anxiety change	0.22 (−0.02, 0.46)	1.01 (0.77, 1.24)	0.79 (0.46, 1.11)	<***.001***[a]
Nausea change	0.18 (−0.03, 0.39)	0.47 (0.27, 0.68)	0.29 (0.01, 0.58)	***.044***[a]
Mood change	0.07 (−0.05, 0.19)	0.83 (0.71, 0.96)	0.76 (0.59, 0.94)	<***.001***[a]
Pain improvement	0.41 (0.34, 0.50)	0.73 (0.64, 0.80)	3.77 (2.27, 6.26)	<***.001***[b]
Anxiety improvement	0.71 (0.62, 0.78)	0.94 (0.90, 0.97)	6.69 (3.28, 13.63)	<***.001***[b]
Nausea improvement	0.86 (0.79, 0.91)	0.95 (0.89, 0.98)	3.17 (1.19, 8.48)	***.022***[b]
Mood improvement	0.41 (0.32, 0.50)	0.86 (0.79, 0.91)	9.13 (5.02, 16.62)	<***.001***[b]
Total dose of narcotics	175.04 (137.60, 212.48)	1.69.60 (133.30, 205.91)	−5.43 (−57.59, 46.72)	.84[c]
Total dose of antiemetics	0.68 (0.43, 0.94)	0.70 (0.45, 0.95)	0.02 (−0.34, 0.38)	.92[c]
Length of stay	2.62 (2.35, 2.89)	2.74 (2.48, 3.00)	0.12 (−0.26, 0.49)	.54[c]

Note. The values in bold italic represent values that are statistically significant.
[a]Linear mixed effect model result.
[b]Logistic regression with GEE result.
[c]Linear model result.

session the therapist had to let the research assistant know the session was over. In addition, data were collected on an inpatient population in a tertiary care center and is not necessarily generalizable to other settings.

Many with severe nausea refused to participate because of how they were feeling. This may be one reason why nausea was not a commonly addressed goal. It was difficult to tease out the narcotic and antiemetic usage, and compare the times they were given with the times of the MT session. This may explain why it was not possible to see any differences in the usage of these medications.

Although patients were appreciative of MT postsurgery, many stated that they wish they could have had it presurgery as they were experiencing anxiety waiting for the surgery to begin. Future research could test the effects of providing MT services before and after surgery. The retention of effect of MT sessions (particularly if the patients are taught ways to use music to address their symptoms at home) and the cost-effectiveness of MT interventions are other questions to address in future studies. Because of the increased number of knee and hip replacements done each year, it is important to find interventions that could help these patients deal with postsurgical symptoms and potentially hasten their recovery. Therefore, research regarding the impact, value, and efficacy of MT could prove to be beneficial to patients, to healthcare institutions, and to society.

Conclusion

This study demonstrated the efficacy of MT in improving pain, anxiety, mood, and nausea for patients following elective orthopaedic surgeries. To the best of our knowledge, this is one of the first studies to investigate the use of MT, as conducted by a board-certified music therapist, in this patient population. It is also unique in its use of a wide variety of interventions to address various goals, resulting in highly individualized sessions. Based on these findings, MT should be used more frequently post-elective orthopaedic surgeries to aid in managing symptoms such as pain and anxiety. Further research is needed to better understand the efficacy of MT before and after orthopaedic surgery in a variety of settings.

Acknowledgments

The authors thank Maria Jukic for her support; Deborah Bucar, Mary Ann Donovan, Mary Ann Winch, and Joyce Smith, the Pre-Admission Testing Nurses; Stephanie Morris, Laura Higgins, Melissa Onabajo, Sarah Paczak Chappell, and Amy Foye, the music therapists who conducted the music therapy sessions for our patients; and Anastasia Pintur and Tammy Shella, the research assistants. This project was funded internally. No external funding was received.

References

Allred, K. D., Byers, J. F., & Sole, M. L. (2010). The effect of music on postoperative pain and anxiety. *Pain Management Nursing*, *11*(1), 15–25. doi:10.1016/j.pmn.2008.12.002

American Academy of Orthopaedic Surgeons. (2016). *Beyond surgery day: The full impact of knee replacement*. Retrieved from http://www.anationinmotion.org/value/knee

American Music Therapy Association. (2005). *What is music therapy?* Retrieved from http://www.musictherapy.org/about/quotes/

Antall, G. F., & Kresevic, D. (2004). The use of guided imagery to manage pain in an elderly orthopaedic population. *Orthopaedic Nursing*, *23*(5), 335–340.

Bradt, J., Dileo, C., & Shim, M. (2013). Music interventions for preoperative anxiety (Review). *The Cochrane Library*, *6*(6), CD006908.

Bruscia, K. E. (2014). *Defining music therapy (3rd ed)*. University Park, IL: Barcelona.

Cepeda, M. S., Carr, D. B., Lau, J., & Alvarez, H. (2006). Music for pain relief. *Cochrane Database of Systematic Reviews*, *2*. doi:10.1002/14651858

Dotinga, R. (2015). Number of hip replacements has skyrocketed, U.S. report shows. HealthDay. Retrieved from https://consumer.healthday.com/senior-citizen-information-31/demographic-arthritis-news-37/number-of-hip-replacements-has-skyrocketed-u-s-report-shows-696419.html

Easter, B., DeBoer, L., Settlemyre, G., Starnes, C., Marlowe, V., & Tart, R. C. (2010). The impact of music on the PACU patient's perception of discomfort. *Journal of PeriAnesthesia Nursing*, *25*(2), 79–87. doi:10.1016/j.jopan.2010.01.017

Eckhouse, D. R., Hurd, M., Cotter-Schaufele, S., Sulo, S., Sokolowki, M., & Barbour, L. (2014). A randomized controlled trial to determine the effects of music and relaxation interventions on perceived anxiety in hospitalized patients receiving orthopaedic or cancer treatment. *Orthopaedic Nursing*, *33*(6), 342–351. doi:10.1097/NOR.0000000000000098

Eisenman, A., & Cohen, B. (1995). Music therapy for patients undergoing regional anesthesia. *AORN Journal*, *62*(6), 947–950.

Engwall, M., & Duppils, G. S. (2009). Music as a nursing intervention for postoperative pain: A systematic review. *Journal of PeriAnesthesia Nursing*, *24*(6), 370–383. doi:10.1016/j.jopan.2009.10.013

Evans, D. (2002). The effectiveness of music as an intervention for hospital patients: A systematic review. *Journal of Advanced Nursing*, *37*(1), 8–18.

Gallagher, L. M., Lagman, R., Walsh, D., Davis, M. P., & LeGrand, S. B. (2006). The clinical effects of music therapy in palliative medicine. *Support Care Cancer*, *14*, 859–866.

Good, M., Stanton-Hicks, M., Grass, J. A., Anderson, G. C., Lai, H. L., Roykulcharoen, V., & Adler, P. A. (2001). Relaxation and music to reduce postsurgical pain. *Journal of Advanced Nursing*, *33*(2), 208–215.

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap): A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Information*, *42*(2), 377–381.

Horrigan, B. (2013). *Easing pain and improving patient satisfaction with integrative care*. Retrieved from http://www.hhnmag.com/articles/5871-easing-pain-and-improving-patient-satisfaction-with-integrative-care

Ignacio, J. J., Chan, M. F., Teo, S. H., Tsen, L. M., & Goy, R. (2012). Research in brief—The effect of music on pain, anxiety, and analgesic use on adults undergoing an orthopaedic surgery: A pilot study. *Singapore Nursing Journal*, *39*(4), 49–51.

Lin, P. -C. (2011). An evaluation of the effectiveness of relaxation therapy for patients receiving joint replacement surgery. *Journal of Clinical Nursing*, *21*, 601–608. doi:10.1111/j.1365-2702.2010.03406.x

Lukas, L. K. (2004). Orthopedic outpatients' perception of perioperative music listening as therapy. *Journal of Theory Construction & Testing*, *8*(1), 7–12.

MacDonald, R. A. R., Mitchell, L. A., Dillon, T., Serpell, M. G., Davies, J. B., & Ashley, E. A. (2003). An empirical investigation of the anxiolytic and pain reducing effects of music. *Psychology of Music*, *31*(2), 187–203.

Ni, C. H., Tsai, W. H., Lee, L. M., Kao, C. C., & Chen, Y. C. (2012). Minimising preoperative anxiety with music for day surgery patients—a randomized clinical trial. *Journal of Clinical Nursing*, *21*(5/6), 620–625.

Nilsson, U., Rawal, N., & Unosson, M. (2003). A comparison of intraoperative or postoperative exposure to music: A controlled trial of the effects on postoperative pain. *Anaesthesia*, *58*, 699–703.

Ottaviani, S., Jean-Luc, B., Thomas, B., & Pascal, R. (2012). Effect of music on anxiety and pain during joint lavage for knee osteoarthritis. *Clinical Rheumatology*, *31*, 531–534. doi:10.1007/s10067-011-1925-9

Parker, R. J. (2011). Evidence-based practice: Caring for a patient undergoing total knee arthroplasty. *Orthopaedic Nursing*, *30*(1), 4–8. doi:10/1097/NOR.0b013e3182057451

Pellino, T. A., Gordon, D. B., Engelke, Z. K., Busse, K. L., Colllins, M. A., Silver, C. E., & Norcross, N. J. (2005). Use of nonpharmacologic interventions for pain and anxiety after total hip and total knee arthroplasty. *Orthopedic Nursing*, *24*(3), 182–190.

Phipps, M. A., Carroll, D. L., & Tsiantoulas, A. (2010). Music as a therapeutic intervention on an inpatient neuroscience unit. *Complementary Therapies in Clinical Practice*, *16*, 138–142.

Rogers, A. (1981). In: Third World Congress on Pain of the International Association for the Study of Pain, Edinburgh, Scotland, September 4–11, 1981, Abstracts. *Pain Supplement*, *1*, S1–S319.

Simcock, X. C., Yoon, R. S., Chalmers, P., Geller, J. A., Kiernan, H. A., & Macaulay, W. (2008). Intraoperative music reduces perceived pain after total knee arthroplasty. *Journal of Knee Surgery*, *21*, 275–278.

World Medical Association. (2016). *WMA declaration of Helsinki: Ethical principles for medical research involving human subjects*. Retrieved from https://www.wma/net/en/30publications/10policies/b3