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Effect of music therapy on pain and anxiety during third molar surgery

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Music therapy has been used with promising results to reduce pain and anxiety in surgical specialties. It is suggested to reduce anxiety and pain perception during dental surgeries and thereby improving clinical outcomes. **Aim:** The aim of this study is to determine whether listening to music during trans-alveolar mandibular third molar extraction reduces pain perception and anxiety. **Methods:** One hundred and forty-six adult participants were randomized into music and non-music groups, with each group comprising seventy-three participants. Each participant had trans-alveolar third molar extraction with or without music intervention depending on the group randomly assigned. Pain scores of participants were measured at one minute after consent, during and after administration of local anaesthetic, during osteotomy, after tooth delivery, and one minute after flap closure. Postoperative pain scores were recorded at one-hour, 3-hour, 6-hour, 24-hour and 48-hour after the last stitch. Pre- and post-operative anxiety scores were also recorded. Descriptive statistics was used to describe sociodemographic data. Student t-test was used to compare the mean of quantitative variables between the groups while chi-square test was used to compare proportions and to investigate association between categorical variables. The statistical significance was defined at $p<0.05$. **Results:** The study showed similar sociodemographic characteristics, baseline clinical features and duration of surgery between groups. Pain score peaked during local anaesthetic administration ($p = 0.254$) and at 3 hours after surgery ($p = 0.170$) but no statistically significant difference was observed in the mean pain score. The mean anxiety scores also revealed no statistically significant differences. **Conclusion:** Music was found to add no significant anxiolytic and adjunctive analgesic benefit to participants who underwent third molar surgeries in this study.

Keywords: Pain. Music. Molar, third. Tooth extraction.

Introduction

Impacted third molar surgery is a common minor operation associated with few risks[1] but for many patients, it is intensely frightening from a psycho-emotional perspective[1-3]. The anxiety and tension that arise during the procedure constitute a high-stress clinical circumstance that influence perioperative pain intensity especially when performed under local anaesthesia[4,5].

To manage patients' anxiety and pain during surgical interventions, various pharmacologic approaches have been used. However, these medications are associated with side effects, elevated cost and need for specialized training[5]. To mitigate this, non-pharmacologic techniques, including music therapy, have been proposed[2,5,6].

Music therapy is a non-invasive, safe, and inexpensive intervention that has been well-investigated in various surgical specialties to aid postoperative recovery[2,5]. Its benefit is attributed to its effect on the perception of pain intensity and autonomic nervous system[5]. However, there are contrasting evidences about the anxiolytic and analgesic effect of music therapy for third molar surgery[2,5,7]. Of importance to this exploration among an African population is the established racial difference in pain perception[8] and music preferences[9] since most studies in the literature on this subject were conducted among the Caucasians. The literature search yielded a study that examined the effect of music therapy on haemodynamic balance without assessing its effect of pain and self-reported anxiety[4]. Exploring the benefit of music in third molar surgery on pain and self-reported anxiety will therefore provide additional information about this subject, thus, enriching the literature.

The study objective is to evaluate the effectiveness of music therapy in reducing pain intensity and anxiety in patients undergoing impacted third molar surgery by testing the hypothesis that music therapy has no anxiolytic and analgesic effect during the procedure.

Materials and Methods

Study design: This is a randomized clinical trial (PACTR202310681115588) which was carried at the oral surgery clinic of the University College Hospital, Ibadan, Nigeria over a one-year period. One hundred and forty-six consenting adult between 21 and 55 years attending the clinic for third molar surgery were enlisted[10,11]. The sample size calculation was done using sample size formula for comparative studies with adjustment for attrition based on a similar study[2,12]. Inclusion criteria for the study included patients who had impacted mandibular third molar indicated for extraction with a Pederson Difficulty Index of 6 and below. Using the periapical radiograph of the impacted tooth, preoperative prediction of extraction difficulty was done by a specialist registrar. This was validated by a consultant oral and maxillofacial surgeon of 20 years post-qualification experience using the criteria of Pederson index (Table 1)[13].

Other inclusion criteria were patients with no history of ear disease, no acute pain. Patients with medically compromised state, history of allergy to local anaesthetic agent, cognitive disorders, peptic ulcer disease, headphone intolerance and those

who declined participation were excluded from the study. All participants in the study were enlisted once. The minimum interval from the last surgery for all presenting participant was one year.

Table 1. Pederson Difficulty Index

Spatial relationship (S)	
Mesioangular	1
Horizontal/Transverse	2
Vertical	3
Distoangular	4
Depth (D)	
Level A	1
Level B	2
Level C	3
Ramus relationship (R)	
Class 1	1
Class 2	2
Class 3	3
Difficulty (S+D+R)	
Very difficulty	7-10
Moderately difficult	5-6
Slightly difficult	3-4

Sampling and Randomisation: Participants were recruited using convenience sampling with equitable gender distribution. Each eligible participant picked a ballot depending on sex from either of the two boxes labelled "Male" and "Female" after shuffling. The "Male" box contained 36 ballots for music and 37 ballots for non-music while the number of music and non-music ballots was reversed in the "Female" box to ensure equitable gender distribution and group assignment.

Procedure: A proforma containing participant demographics, vital signs, weight, height, body mass index, Pederson Difficulty Index score was completed. Other information included history and indication of previous third molar surgery, music preference including type, genre and where applicable, specific choice(s) of music that relaxes each participant. Each participant provided at least ten music list using music tracks, author/artiste and/or genre. The trait version of the State and Trait Anxiety Inventory was filled by each participant to assess the general anxiety predisposition. A three-day to one-week appointment for surgery was then given. Each participant's preferred music tracks were sourced online from *www.tubidy.com*.

On the appointment day, a multiparameter vital sign monitor (Contec CMS 6000A) with 5-lead electrodes, pressure cuff and pulse oximeter was fixed to the participant's anterior chest wall, left arm and left thumb respectively, three minutes after participant was seated in the quiet operating room. Baseline blood pressure, respiratory rate, pulse rate and pain intensity using the numeric pain scale (NRS)

were recorded. After the baseline readings, the selected tracks were played in continuous shuffle mode but soft tone from a MacBook Pro Computer (Apple, Inc.) through an external speaker (Havit Inc; HV-SF5626BT) for the study group. This continued through the informed consent stage and till the commencement of surgery. For participants in the control group, the stages progressed without the administration of music.

Informed consent was obtained after the details of study and surgical procedure including possible sequelae have been explained to the patient verbally and provided in print. After informed consent, the STAI-S (State Anxiety) questionnaire was administered to the participant and pain score was repeated. Music administration via external speaker was switched automatically to a bluetooth Touch headphone (HAVIT 160) just before local anaesthetic administration. This continued till the placement of the last stitch.

All the surgical procedures were completed by the same surgeon. Local anesthetic agent (2% Lidocaine 1:100,000 epinephrine based on 1.8mL cartridge within the 7mg/kg maximum acceptable dose range) was thereafter administered using Halstead direct technique[14]. The number of local anesthetic cartridge used to achieve anaesthesia was recorded. Three-sided full mucoperiosteal flap was raised using No. 15 scapel in a #3 Bard Parker handle and Molt's periosteal elevator. Osteotomy was done for all participants with straight and/or contra-angle handpieces with round stainless-steel surgical bur under copious 0.9% normal saline irrigation. Where necessary, tooth sectioning was done with the straight and/or contra-angle handpiece with either round or cylindrical surgical bur under copious saline irrigation. Index tooth was elevated out of socket using combination of Coupland elevators (#1, #2, #3) or Cryer elevators en-masse or in sectioned parts.

After tooth delivery, tooth socket was irrigated using 0.9% normal saline and the socket was inspected. Haemostasis was achieved using gauze pack after which surgical site was sutured with 3/0 black silk suture adopting horizontal mattress technique. Pressure gauze pack was replaced, after flap suturing. After placement of last stitch, music was switched back from headphone to external speaker signaled by a prompt, and state anxiety (STAI-S) was readministered.

Postoperative instruction was given to each participant verbally and in print. The participants were discharged home on Cap: Amoxil™ (GlaxoSmithKline) 500mg 8hourly for 5 days, Tab: Flagyl (Sanofi-Aventis) 400mg 8hourly for 5 days and Tab: Clofenac (Hovid) 50mg 12hourly for three days, and scheduled for follow up. The pain scoring was recorded at intervals as follows: one minute after informed consent, during and after administration of local anaesthetic, during osteotomy, after tooth delivery, one minute after the last stitch and one-hour after the last stitch. Participants were subsequently discharged home with postoperative medications.

The same procedure described above was followed for the non-music group without administration of music. Participants were seen forty-eight hours after extraction for follow up and sutures were removed for all participants one week after extraction. Participants were called via phone at one-, three-, six-, twelve-, twenty-four and forty-eight hours after last stitch to record pain scores.

Data Analysis: Data collected were entered in a proforma by a trained dental surgery technician. The data was subsequently entered into computer spread sheet. IBM SPSS version 20 software was the statistical package used for analysis. Descriptive statistics including means and standard deviation was used to describe age, body mass index, pain scores (NRS) and anxiety parameters that were analysed in the study. Normality of data distribution was tested using Shapiro-Wilk test. Student t-test was used to compare mean for quantitative variables between the groups. The chi square test was used to compare proportions and to investigate association between categorical variables such as depth and type of impaction, difficulty index. Statistical significance was defined at $p<0.05$.

Ethical considerations: This study was conducted under strict compliance with the Helsinki Declaration of 1964. Ethical clearance to conduct this study was obtained from the University of Ibadan/University College Hospital Ethics Review Committee (UI/UCH EC Approval Number: UI/EC/17/0042). Verbal and written consent was obtained from each participant and information obtained from each participant was treated with utmost confidentiality and privacy using codes and anonymous proforma.

Results

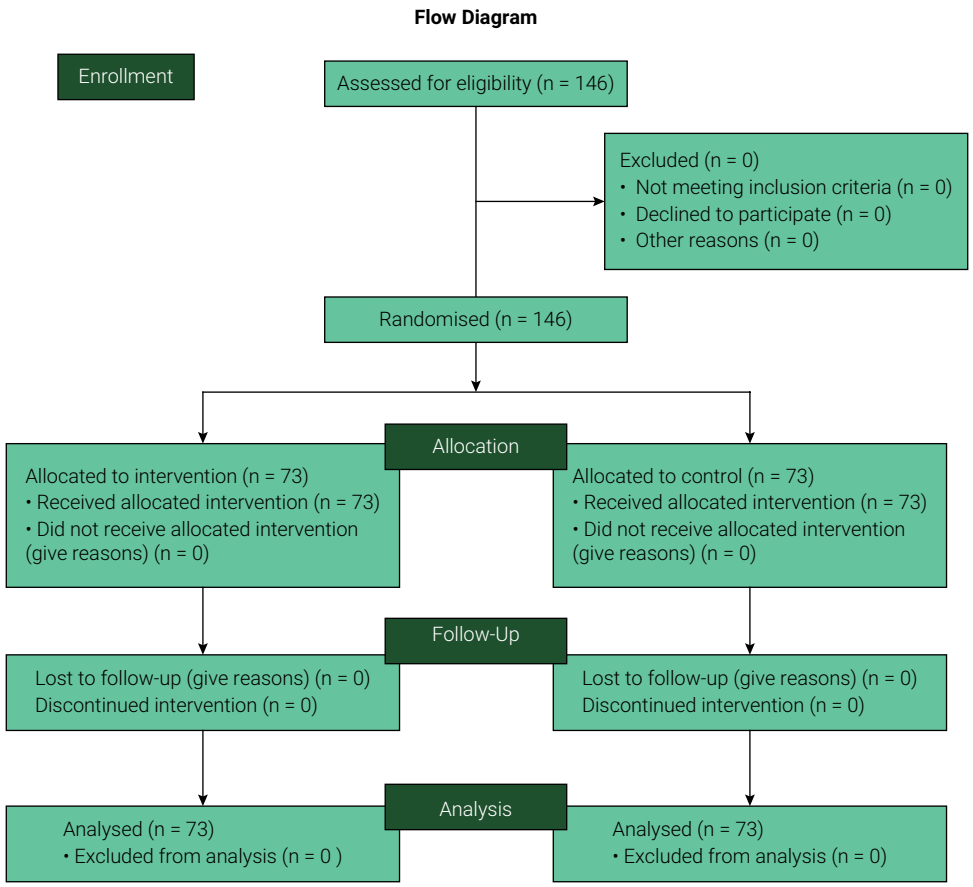

Figure 1. Study Flow Chart

Sociodemographic data of study participants

Participants in the music and control groups show similar sociodemographic characteristics in terms of age, body mass index, level of education and occupation as shown in Table 2. The gender was equitably distributed between groups.

Table 2. Distribution of sociodemographic characteristics of study participants

Continuous Variables	Music N=73	Non-music N=73	Total	p-value
Mean age in years (SD)¶	29.1(9.9)	30.8(9.7)	29.87(9.34)	0.288
Age range in years	21.0-55.0	21.0-53.0	21.0-55.0	
Mean BMI* (SD)¶	23.6(4.1)	23.9(4.4)	23.73(4.3)	0.722
Categorical Variables				
Sex (%)†				0.254
Male	36(49.3)	37(50.7)	73(50)	
Female	37(50.7)	36(49.3)	73(50)	
Age range in years (%)†				0.552
21-25	33(45.2)	27(37.0)	60(41.1)	
26-30	18(24.7)	21(28.8)	39(26.7)	
31-35	7(9.6)	6(8.2)	13(8.9)	
36-40	6(8.2)	7(9.6)	13(8.9)	
41-45	2(2.7)	4(5.5)	6(4.1)	
46-50	5(6.8)	2(2.7)	7(4.8)	
51-55	2(2.7)	6(8.2)	8(5.5)	
Level of Education (%)†				0.339
Secondary	3(4.1)	3(4.1)	6(4.1)	
Tertiary	52(71.2)	54(74.0)	108(74.0)	
Postgraduate	18(24.7)	16(21.9)	34(23.3)	
Marital status (%)†				0.141
Single	54(74.0)	47(64.4)	101(69.2)	
Married	19(26.0)	26(35.6)	45(30.8)	
Occupation (%)†				
Students	37(50.7)	29(39.7)	66(45.2)	0.682
Civil servant	8(11.0)	7(9.6)	15(10.3)	
Skilled worker	9(12.3)	15(20.5)	24(16.4)	
Professional	7(9.6)	9(12.3)	16(11.0)	
Business / trader/ artisan	11(15.1)	11(15.1)	22(15.1)	
Unemployed	1(1.4)	2(2.7)	3(2.05)	

No statistically significant difference between the two groups (p>0.05)
*BMI = Body Mass Index in kg/m^2 ¶ Student t-test analysis † Chi-square analysis

Baseline features of impacted mandibular third molar under study

There was no statistically significant difference between the terms of surgery of the two groups, suggesting that the baseline characteristics of the third molars under study were not different. Details of the distribution of terms of surgery among study participants is shown in Table 3.

Table 3. Distribution of baseline features of extracted third molar among study participants.

Variables	Group		χ^2 test	p-value
	Music N(%)	No music N(%)		
Oral location of tooth			0.110	0.434
Right Molar	35(47.9)	33(45.2)		
Left Molar	38(52.1)	40(54.8)		
Previous Third Molar Surgery				
Yes	22(30.1)	21(28.8)	0.033	0.500
No	51(69.9)	52(71.2)		
Pederson Difficulty Index				
3.00	2(2.7)	3(4.1)		
4.00	16(21.9)	15(20.5)	1.161	0.762
5.00	26(35.6)	21(28.8)		
6.00	29(39.7)	34(46.6)		
Indication for extraction				
Pericoronitis	70(95.9)	70(95.9)		
Pulpitis	0	2(2.7)		
Prophylaxis	0	1(1.4)	6.000	0.999
Orthodontics	1(1.4)	0		
Dentoalveolar abscess	2(2.7)	0		

Baseline values of outcome variables

Baseline characteristics of outcome variables were not statistically significant between test and control groups as shown in Table 4.

Table 4. Outcome Variables at Baseline

Time interval	Group		t- test	p-value
	Music (Mean+SD)	No music (Mean+SD)		
Baseline Pain Score (NRS)	0.16+0.76	0.30+1.10	0.873	0.384
Systolic Blood Pressure (mmHg)	131.2+13.3	130.5+20.5	0.235	0.815
Diastolic Blood Pressure (mmHg)	83.1+10.7	80.6+11.8	1.344	0.181
Respiratory Rate (cycles per minute)	19.3+4.6	19.2+4.5	0.126	0,900
STAI-T (Trait)	40.30+7.98	42.67+7.24	-1.905	0.059

No statistically significant difference between study groups at baseline p>0.05
Using Shapiro-Wilk test, baseline data is normally distributed p>0.05

Duration of Surgery

The duration of surgery is comparable between groups both in terms of range and mean. The mean duration from the time of first incision to the time of last stitch was 28.14+12.32minutes for the music group and 29.76+12.31minutes for the non-music group as shown in Table 5 below.

Table 5. Comparison of the duration of surgery between the music and non-music groups of study participants

Time	Music Mean (SD) (minutes)	t-test	p-value	Minimum Duration in minutes	Maximum duration in minutes
Mean duration of surgery		-0.794	0.429		
Music group	28.14(12.32)			10	60
Non-Music group	29.76(12.31)			13	55

Intraoperative mean pain score distribution

Figure 2 shows no statistically significant difference in the mean pain score between the two groups.

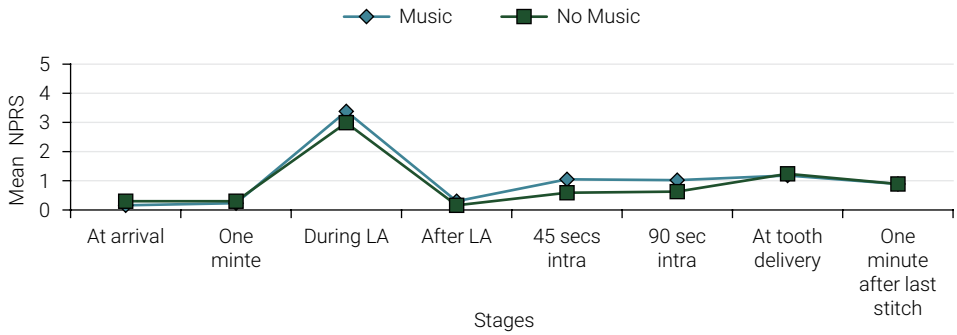

Figure 2. Line graph showing mean pain score (NRS) for both groups

Postoperative pain severity levels at different intervals

The mean pain scores were in the higher ranges within the first 12 hours after which there was decline for both groups. Notably also, the highest pain scores were at the 3-hour reading for the two study groups [5.0±3.0 (music) and 4.4±2.9 (non-music)]. The pattern and comparison of postoperative pain score over the first 48-hour postoperative period is shown in Table 6. There was no statistically significant difference between the groups at any interval.

Table 6. Comparison of pain scores at different interval between the music and non-music groups of study participants.

Time interval (hours)	Group		t-test	p-value
	Music Mean+SD	No music Mean+SD		
After last stitch NRS	0.3+1.25	0.16+0.60	0.841	0.402
1 hour after last stitch NRS	3.0+2.7	3.3+3.1	0.606	0.546
3 hours after last stitch NRS	5.0+3.0	4.4+2.9	1.379	0.170
6 hours after last stitch NRS	2.8+2.2	3.3+2.7	1.099	0.274
12 hours after last stitch NRS	2.7+2.2	2.4+2.3	0.867	0.387
24 hours after last stitch NRS	1.4+1.6	1.3+1.6	0.274	0.784
48 hours after last stitch NRS	1.0+1.6	1.0+1.5	0.162	0.871

Amount of local anaesthetic agent used

Lasting anaesthesia was achieved with two cartridges of 2% Lidocaine 1:100,000 Epinephrine (1.8mL) in 75.3% and 69.4% of music and non-music groups respectively. On the other hand, minority of participants in both music and non-music groups required additional top up doses for maintenance of anaesthesia through the procedure as shown in Figure 3. The difference in the number of local anaesthetic cartridges used was not statistically significant (p=0.677).

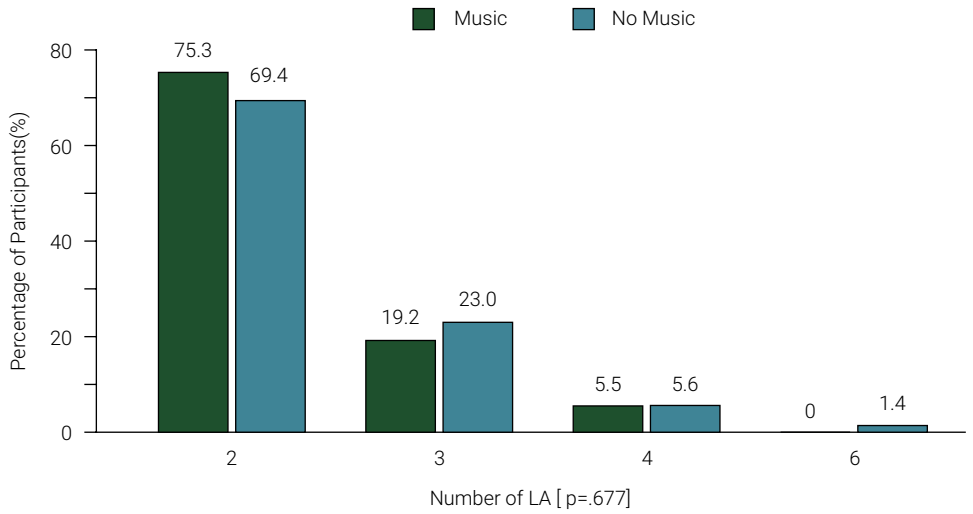

Figure 3. Distribution of number of local anaesthetic agent (1.8mL per cartridge) between groups

Anxiety scores between study groups

No statistically significant difference was observed between the mean anxiety measures for both study groups Table 7. The report of anxiety categories in the perioperative period are shown in Table 8. There was no statistical difference observed between severity of anxiety in both groups.

Table 7. Comparison of mean anxiety scores between the music and non-music groups.

Anxiety measure	Group		t-test	p-value
	Music Mean+SD	Non- music Mean+SD		
Trait Anxiety	40.30+7.98	42.67+7.24	-1.905	0.059
State Anxiety (pre)	40.38+8.51	39.56+9.11	0.508	0.612
State Anxiety (post)	35.71+12.04	36.95+10.58	-0.634	0.527

Table 8. Comparison of anxiety severity levels between participants in the music and non-music groups.

Stage	Severity of anxiety	Group		χ^2 test	p-value
		Music N(%)	Non-music N(%)		
Trait Anxiety	mild anxiety	38(52.1)	29(39.7)	3.491	0.175
	moderate	34(46.6)	44(60.3)		
	severe anxiety	1(1.4)	0(0.0)		
State Anxiety (pre)	mild anxiety	38(52.1)	40(54.8)	1.066	0.587
	moderate	34(46.6)	33(45.2)		
	severe anxiety	1(1.4)	0(0.0)		
State Anxiety (post)	mild anxiety	45(66.2)	39(60.0)	1.695	0.428
	moderate	22(32.4)	26(40.0)		
	severe anxiety	1(1.4)	0(0.0)		

Discussion

This study set out to evaluate the effect of music on anxiety and pain during impacted mandibular third molar surgery. From the findings of this study, there was no evidence that supports the analgesic and/or anxiolytic effect of music during transalveolar extraction of impacted third molars. This is in contrast to earlier studies which demonstrated that non-surgical aspects of invasive dental treatment such as patients' behavioural modification and music intervention may be useful for achieving better clinico-emotional results for patients, and improve the quality of treatment by reducing pain and anxiety[2,15-19]. The opposing evidences was assumed to result from racial differences that exist in music preference and pain perception[8,9,20].

The sociodemographic characteristics and radiographic index of difficulty of impacted third molars in this study are similar between groups. The majority of participants are in their third decade of life in agreement with previous studies[2,21]. Mesioangular impaction was the most common pattern in agreement with reports from earlier studies[2,22-24] and the current study found pericoronitis to be the most common reason for presentation at the clinic[2,17,22].

The most severe intraoperative pain was reported during local anaesthetic injection while the worst pain after extraction was reported three hours after the last stitch. Needle penetration, chemical irritation and rapid tissue distension could evoke pain

at the site of injection by stimulating pacinian corpuscles, mechanoreceptors and the Ruffini endings whose afferent impulses are carried along the A-δ fibres[25]. A report of pain after dental nerve block is affected by the depth and duration of action of the local anaesthetic used[26]. The analgesic effect of 2% Lidocaine HCl 1:100,000 epinephrine lasts for 80-90 minutes on the pulp and up to two and half hours in soft tissue[24,27-29]. For an average surgical time of about thirty minutes, the effect of pulpal and soft tissue anaesthesia from lidocaine would have waned two-and-half hour after flap closure leading to intense surgical pain at this period. This finding agrees with other studies in the literature[30-32].

Contrariwise, De Menezes and Cury[33] reported that postoperative pain peaked between 8-12 hours after impacted mandibular third molar surgery. In the study, evaluation of pain was done only at 8-12-hour, 12-24 hour and after 24 hours without recording pain scores in the first eight hours. This creates an information bias that excluded important information about patient's pain experience in the early postoperative hours. Notwithstanding, this study showed no statistically significant difference in pain perception between the test group and the control group in the postoperative period.

Sen et al. [34] found a significant analgesic effect of music therapy on postoperative pain after elective caeserian section. A statistically significant reduction in postoperative pain was reported in the first 24 hours along with a decrease in analgesic consumption in the first four hours compared with control. In agreement with Sen et al.[34], Vaajoki et al.[15] compared the effect of music on pain intensity and distress after abdominal surgery. The authors found that listening to music can alleviate patient's pain in the second postoperative day (p=0.02). In third molar surgery, as in other osseous surgeries, there is a significant disruption of the normal bone tissue architecture and possibly more intense inflammatory response within an inexpansible osseous compartment. For example, in orthopaedics where osseous tissue procedures dominates, music intervention had conflicting results[16,35]. In a study to examine the effect of intraoperative music therapy after total knee arthroplasty, Simcock and colleagues[16] found a statistically significant reduction in the pain intensity at 3-hours and 24 hours. Even though this trend was also observed at 6th hour, that did not reach a statistically significant level. Contrary to this, Allred et al.[35] did not find statistically significant difference in the pain scores between the music and non-music groups among fifty-six arthroscopic surgery patients. This suggests that responses to music with respect to pain perception may differ between surgeries on soft and bony tissues due to greater nociceptive nerve density in the periosteum than muscle[36,37].

Participants' anxiety was not influenced by music in the perioperative period in this study. There was comparable anxiety characteristics at baseline, and in the perioperative period as shown by the trait and state anxiety scores. These findings suggest that the use of music is of no benefit in modifying the anxiety of patients undergoing impacted third molar surgery. In agreement with this study, Kim et al.[2] found no significant difference in anxiety score between groups in the postoperative period. It was further revealed that patients' selection of the type of music, as advocated by some investigators[38-40], did not influence the effectiveness of music intervention.

These findings are in contrast to another study where significant anxiolytic effect of music was reported during dental treatment among middle-school children[41]. In this group, self-reported anxiety, systolic blood pressure and pulse rate were significantly reduced compared to the control group. In younger children aged 4-6 however, the level of anxiety, disruptive behaviours and pain did not differ between the study group and control[41]. Although the current study did not investigate the vital signs changes in the perioperative period, a study of the effect of music on haemodynamic balance during third molar surgery in an African population showed no benefit[4,42]. Dental anxiety is a complex phenomenon affected by personality characteristics, fear of pain and previous experiences[41]. It can be argued that individual differences in personality change are present in the transition from adolescence through adulthood and that personality traits remain more stable following maturation[43]. Although, the state anxiety reflects an emotional response while coping with threatening situations, it is moderated by individuals' trait anxiety which is an enduring personal dispositions to fright irrespective of environmental variations such as music intervention[43,44].

Limitation of study

Other indicators of anxiety and stressful medical situations such as glucose and cortisol level, haemodynamic changes and temperature were not included as outcome parameters of this study[5]. These variables in addition to the study findings may have provided more comprehensive clinical picture about the subject of interest reflecting internal stress and not just patient's subjective interpretations of the clinical situation.

In conclusion, the findings of this study agree with previous studies which have largely rejected the supposition that music therapy may provide co-analgesic and anxiolytic effects during impacted third molar surgery. The study also shows that there is no evidence to support racial difference in pain behaviour and anxiety states in response to music therapy in third molar surgery.

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Conflict of interest

None.

Data availability

Datasets related to this article will be available upon request to the corresponding author.

Author contribution

Olusegun I. Olaopa: conceptualization, data curation, methodology, investigation, data analysis, project administration, resources, writing – review and editing, funding; Olalere O. Gbolahan: methodology, project administration, supervision, writing – review and editing; Adeola A. Olusanya: methodology, project administration, supervision, writing – review and editing; Olubayo A. Fasola: methodology, project administration, supervision, writing – review and editing; Juwon T. Arotiba: methodology, writing – review and editing. All authors actively participated in the manuscript's findings and have revised and approved the final version of the manuscript.

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