Summary report: Agile Seed Funding Nov 2023 – Oct 2024

Is singing beneficial for the jaw?

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Background and Objectives: Five to 12% of adults live with chronic disabling orofacial pain that affects the masticatory muscles (myalgia) and/or TMJs (arthralgia). These are the most common types of painful temporo-mandibular disorders (pTMDs), conditions in which biological, psychosocial, and other factors are believed to play an etiological role. pTMDs are linked to limited jaw function. There is no cure for chronic pTMDs; instead, they are managed with occlusal appliances, physical therapy (e.g., relaxation, stretching), pharmacological treatments, and rarely, surgical intervention.

Singers are occupational users of the head and neck. Their training teaches them to precisely control the position of their jaw, lips, and tongue to create sound characteristics, in particular vibrato. It is unknown whether specific movement and motor patterns are associated with the quality of singing and resulting vibrato, and whether these learned muscle patterns allowing precise control are beneficial for oral health.

Our long-term goal is to investigate the health-related aspects of singing. The aim of this project supported by the CIRMMT Agile Seed Funding was to investigate jaw movement, muscle activity and vibrato regularity in singers and non-singers, who have and do not have pTMD. *The overarching hypothesis is that healthy singers have motor patterns that are beneficial to TMJ function.*

Accomplishments: With the CIRMMT Agile Seed Funding and the infrastructure at CIRMMT, we completed data collection for this study. We recruited a total of 52 people to take part in the study (n = 15 singers with pTMD, n = 12 singers with no pTMD, n = 12 non-singers with pTMD, n = 13 non singers no pTMD). Participants filled out a survey describing their musical background and pTMD-related questionnaires. At CIRMMT, we performed motion capture to measure jaw kinematics and surface electromyography (sEMG) to measure muscle activity. The sEMG sensors were placed on the bilateral masseter and temporalis. Motion capture, sEMG and sound recordings were collected while the participants performed range of motion as well as speaking and singing exercises using different consonant-vowel combinations. We designed an intra oral device attaching to the lower incisors. The intra oral device was 3D printed for each participant and used to validate the motion capture markers on the skin.

Use of funds: The funds covered gift cards for the participants to reimburse them for their time. Each participant received a $40 Amazon gift card for a total of $2080 in gift cards. The funds also covered a part-time student research assistant (Theodora Nestorova) to create a video instructing participants what to do during the test and to aid in collecting data ($2,042 for 7 hours/week over 8 weeks). Lastly, the funds covered $712 of supplies, including adhesives for motion capture markers and sEMG sensors as well as acrylonitrile butadiene styrene material for 3D printing of the intra oral devices.

Outcomes: Overall, three graduate students were trained to use the motion capture and sEMG devices to perform the study. We successfully completed the data portion of the study on 52 participants. To process the mocap data, we have created a script that reduces the data to 2D movement on the sagittal plane to measure jaw opening distance and jaw opening angle. We have also created a script that processes the sEMG data by filtering it.

With the data and the analysis scripts we are processing the data. First, we are processing the results of the questionnaire, the mean sEMG activity during maximum voluntary clench as well as the mean mouth opening and mean angle during maximum mouth opening. We are validating the chin sensors as a measure of mouth opening with the intra oral device. We expect to publish the results in 2025.

Next, we will process the mocap and sEMG data for the singing and speaking components. We are planning to use artificial intelligence to identify patterns between the four groups.