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MANUAL DEXTERITY: NEW PERSPECTIVES ON DENTISTRY

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HONORS PROJECT

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Abstract

Having good hand-dexterity and hand-eye coordination are essential skills found in dentistry. Through the exploration of jewelry and metal making processes, a vast number of similarities can be tied to the metal casting process and dental practices used daily in nearly all offices. With a focus on effort and time devoted to the repeated processes of creation and finishing tooth shaped metal rings, an understanding of this relationship can be further understood. First shaped from wax, then casted with silver metal, realistic tooth shaped rings can be created with a correlation to improved manual dexterity. Psychomotor skills are associated to be one of the most significant factors affecting dental performance in and after dental school. They are required skills used to perform tasks such as jewelry making, and practice of these skills are complimentary in nature to observing improvements in both performance and efficiency. Exemplifying a scholarship learning outcome of integrative learning and written communication, a new perspective on manual dexterity and its relation to dentistry is explored.

Introduction

A number of studies have been conducted as researchers attempt to determine the relative significance of manual dexterity in professional fields of dentistry and health. Studies ranging from the early 2000's to more recent studies of less than a year old, provide helpful insight into the connection between having excellent manual dexterity, psychomotor skills, and hand-eye coordination. All of which qualities are comparably the same way to describe the set of skills required to excel in dentistry. Nearly all literature deems manual dexterity to be a crucial skill of dentistry. One study claimed that dexterity is the core of these skills [2]. However, differences arise in the results of the researchers on the necessity of gaining these skills prior to attending dental school. Many studies correlate poor results on psychomotor tests to a lack of participation of these activities prior to dental school, stressing the importance of hobbies like jewelry making and other manual dexterity improving activities [5][7]. Due to the vigorous coursework of dental school, improving dexterity prior to attendance is highly recommended to better adapt to manual practices [9][11]. Some even go a step further to state that a manual dexterity test should be implemented into the admissions process in order to better gauge the success of students in dental school [1][3][4]. This proposes the difficulty of already busy students finding the time and effort to work on improvement by use of these activities as mere "hobbies." Fortunately, some universities do offer jewelry and metals courses with the potential of improving manual dexterity through processes related to dental and medical professions. Although they are not a curriculum requirement in many cases, the use of jewelry making to improve psychomotor skills is not new. Jewelry tools have been used in preclinical laboratories to analyze dexterity, resulting in a positive correlation of wire bending to dexterity skills [8]. Additionally, it is common to find

retired dental tools in jewelry and metal studios due to the extreme precision they provide in practice.

Besides determining the significance of familiarizing one's self with activities affecting manual dexterity, it is important to consider the symbolic meaning of jewelry made of teeth in prehistoric and present times. Many recent discoveries of prehistoric tribes wearing both human and animal teeth as pendants or jewelry opens the conversation about the significance of such pieces. Although the market is relatively small, wearing jewelry made of and shaped as teeth is not hugely uncommon.

Still, past research has lacked to answer a few pivotal questions pertaining to dentistry and jewelry making. Firstly, how closely does working with metals and jewelry relate to dental practices? And secondly, what improvements in hand-dexterity and timely production of a wax model will be observed upon repeated efforts of creating teeth shaped ring? With a focus on effort and time devoted to the processes of creation and finishing multiple products, an understanding of the relationship of these activities can be further understood.

Background

Recent discoveries have led archeologists to believe that the use of human teeth as pendants and jewelry is not as rare as perceived. Thought to have deeper symbolic meanings than just a physically decorative significance, findings have expanded recent knowledge on this subject. Many reports have found teeth used as jewelry in European Middle and Upper Paleolithic, as well as the Near East of Çatalhöyük, Turkey. The findings are dated during the subsequent Mesolithic, Neolithic, and Chalcolithic periods [6]. Within this area of high archeological findings, over thirty-one separate discoveries have identified the use of human

teeth, or bone, for ornamental or symbolic reasons. Reasoning behind why this area is so heavily concentrated is still questioned. However, a more important speculation of research of archeologists has been to determine the significance of the use of teeth for these ornamental purposes.

In a comprehensive study of over 1200 pendants composed of animal teeth in nearly 80 archaeological sites, Tõnno Jonuks and Eve Rannamäe identify the symbolic significance of these pendants reflecting status and relationships [10]. Furthermore, other pendants were speculated to represent power, intimidation, and having religious value. Preparing these pendants in ways very similar to the discovery found at the Neolithic Çatalhöyük site in Turkey, these findings have been presumed to have symbolic meanings to the wearer [12]. The intentional drilling observed in the two recent teeth uncovered in Turkey provided evidence of the seemingly unlikely wearing of these pieces as simply being ornamental, decorative jewelry.

Furthermore, Haddow closes in on the significance of these pieces to the individuals wearing them. The quantity of these findings indicates symbolic importance of the human body with the living and the deceased [6]. Expanding on the use of human teeth for socio-cultural practices, the significance of such pendants and jewelry is further established, which can be tied to the wearing of animal and even human teeth in society today. Although still peculiar, the use of teeth in jewelry is not immensely uncommon.

Materials & Methods

The transformative process began by carving away the negative space surrounding the desired tooth ring shaped from a flat topped, wax tube. This subtractive process is executed with an 8" half round wax file, giving the rough dimensions of the tooth ring. Eventually, smaller flat

and round ¼” files were used to allow for greater precision. Caution must be taken in order to not subtract too much from the ring. Although, if available, melted wax can be added for wax buildups or to fix breakage.

Once a satisfying general structure of the ring was created, precision micro-carving tools and old dental equipment were used to form the realistic structure of a tooth. Three-dimensional meandering roots, found deep in the gums of patients, were shaped to hug the finger. Detailed at a surgical level, the roots, body, and top of the tooth are shaped from what was previously a solid block of wax. This process takes the most time because it is most important for accurate detailing prior to casting the rings. Efficiency of shaping the rings, time devoted toward carving, and process struggles are noted during this phase of the casting process.

The wax is then attached to sprues in an investment cylinder sprue former, resembling a wax tree which will later give way for the flow of molten silver. The Ultra-Vest Jewelry Investment application instructions must then be followed very precisely to create the proper ratio of water to powder ratio to form the hardening liquid investment poured over the rings in the investment cylinder. Upon hardening, the wax and sprues are burned out, creating the hollowed ring formation cemented inside the cylinder. Next, silver metal is melted and injected into the mold, creating the ring. Following this process is cleaning and finishing the piece with various sandpaper grades and use of a mandrel, a high-speed handheld drill, to complete the engraving of the tooth’s surface and polishing it. Thus, giving it the appearance of a real tooth and repeated as many times as necessary.

Results

The wax carving pieces are shown below. Ring 1 is shown in image 1, ring 2 is shown in images 2-5, and ring 3 is shown in images 6-9. The silver casted ring, ring 1, was done in the fall semester of 2019 in Bowling Green State University's jewelry and metals I course. This is the only ring that has been casted thus far because the push to the spring semester to remote learning extinguished the ability of getting into the art studio this semester. Therefore, only the wax carving phase of the casting process is able to be analyzed in the comparison of the three tooth ring models. The effects that Covid-19 to learning and research has been extremely detrimental in many ways. Although plans have been made to cast the other two wax rings, these pieces will not be completed until the summer of 2020. Still, these processes may be compared in great detail demonstrating an increase in efficiency and decrease in time devote to each piece, positively correlating to an increase in manual dexterity by repeated efforts in creating tooth shaped rings.



Image 1

Ring 1 took nearly three full class sessions to complete, totaling roughly 11 hours of work devoted to the wax carving process. As my first interaction with metal materials, many struggles arose resulting in continuously adding new wax to the model. However, the model was

still not finished to a great level of perfection, resulting in many more hours required to smooth and finish the casted piece.



Image 2



Image 3



Image 4



Image 5

Ring 2, the second effort of creating a tooth shaped ring went much more smoothly. Not only were less mistakes made, it only took a total of 3 hours to finish the wax model. Completed in less than desirable conditions at home, rather than the studio, and limited tools, efficiently was

greatly increased. More comfortability was also observed in the much narrower roots and increased groove structures on the top of the molar tooth.



Image 6



Image 7



Image 8



Image 9

Ring 3, the third effort, went even more smoothly than expected as well. This tooth took less than 2 hours to finish the carving process from start to finish. Additionally, this ring has three root tips, requiring more detail of using tools to reach tighter spaces.

Efficiency greatly increases throughout repeated tooth ring creation efforts. Observed in the finished wax product resembling realistic teeth and greatly increase speed, seen in the time

devoted to each ring during the carving phase of the casting process. Upon a third effort, roughly 1/6 the amount of time was necessary to create a piece with more intricate structures.

Furthermore, only a few errors were made in creating ring 2 and zero in the creation of ring 3.

Originally Tom Muir intended to oversee this entire process, including casting both new rings. However, the effects of Covid-19 greatly altered this process of his observation and reference check points at various stages throughout the research. Close communication by phone has made continuation possible.

In regard to the actual casting process, there are many observable similarities to the daily practices of dentists working in the office. For example, the entire process of carving teeth from a wax block is done in just a few minutes by very expensive Cerec machines. Once uncommon, these machines have been very crucial in the daily operations of offices to create crowns. Just a few years ago molds would have to be taken and sent to dental labs, followed by weeks of waiting before calling the patient back to replace the temporary crown for a permanent one. This machine utilizes two drill bristles that work simultaneously to carve porcelain blocks, rather than wax. In addition, the mandrel used to add the finishing touches of detail to the top of the tooth greatly resembles a high-speed dental drill. This is the most commonly used tool in dental procedures and is often used to shape the structure of a crown to fit perfectly in patients' mouths.

Discussion

An undeniable improvement in manual dexterity and hand eye coordination is still observed despite major alternations in the original project proposal, based on the assumption that I would have close contact with the metals and jewelry studio and Tom Muir. Additionally, through the direct use of these practices to actually shape teeth, I have become immensely more

comfortable not only working with tiny objects, but with teeth themselves. There are many other ways to increase manual dexterity as well. Outside of the metals and jewelry studio, activities requiring hand skills or coordination like playing musical instruments, video games, or sports. Putting aside many studies positively correlating improved dexterity skills to better dental practices and performances, increased use of manual activities can lead to better psychomotor skills, efficiency, and timeliness. Who wants their dentist to do poor work or even to have their hands inside their mouth for longer than necessary? No one. Getting a head start on improving dexterity can lead to better performance and less stress during dental school, which many know is already very overwhelming.

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