

Overview

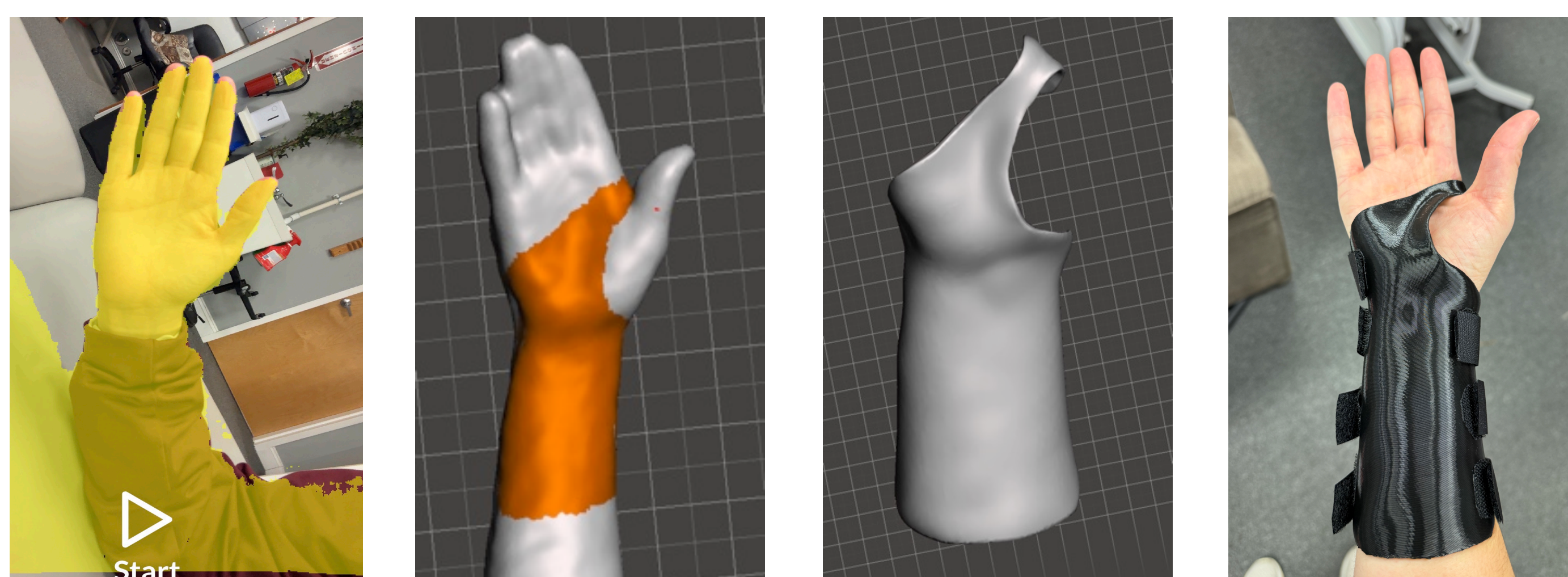
Setting: This capstone was completed at a private outpatient practice specializing in upper extremity (UE) rehabilitation.

Background: Orthoses are devices that are used within UE rehabilitation to either immobilize or improve mobility to promote a patient's function in occupations (Chhikara et al., 2023; Oud et al., 2021; Schwartz & Schofield, 2023). Currently, registered occupational therapists (OTRs) utilize low-temperature thermoplastic (LTT) materials to fabricate orthoses (Chhikara et al., 2023; Oud et al., 2021; Schwartz & Schofield, 2023). However, LTT materials have been found to be time consuming to fabricate during therapy sessions, are bulky in size, and offer low breathability impacting hygiene (Oud et al., 2021; Schwartz & Schofield, 2023; Waldburger et al., 2021). Therefore, there has been a shift to utilize 3D printing materials as an alternative method of orthoses fabrication. They have been found to be lighter in weight, produce less skin irritation, provide improved hygienic practices, and are customizable to fit a client's needs (Barter et al., 2023; Domenighetti & Ozelle, 2024; Irani & Ozelle, 2023; Oud et al., 2021; Oud et al., 2023; Schwartz & Schofield, 2023; Waldburger et al., 2021). However, OTRs rely heavily on engineering professions to fabricate this type of orthosis due to deficiencies in technological skills related to 3D printing (Schwartz & Schofield, 2023). This further impacts an OTR's acceptance and utilization of this fabrication method (Waldburger et al., 2021).

Literature Review Findings: Current research suggests OTRs can utilize their foundational knowledge regarding UE anatomy and clinical conditions to assist in the fabrication process for 3D printed orthoses by positioning the patient in the correct anatomical position to be scanned (Schwartz & Schofield, 2023; Von Haller et al., 2024). OTRs can collaborate with engineers to assist in designing orthoses through computer aided design (CAD) systems as they understand the clinical application for the orthosis design (Keller et al., 2021; Schwartz & Schofield, 2023; Von Haller et al., 2024). Finally, OTRs can ensure the proper fit of the orthosis and provide adjustments accordingly (Keller et al., 2021). However, there is limited evidence to demonstrate the experiences of OTRs that have participated within the process for 3D printed orthoses.

Purpose: Gather experiences of OTRs who have participated in the fabrication process of 3D printed orthoses for UE rehabilitation to understand the role they play in this method to raise the acceptance of using emerging technological advances within this setting to drive patient care.

Research Question: What are the experiences of OTRs in fabricating 3D printed orthoses for orthopedic conditions of the upper extremity?



Learning Objectives

Objective 1: Understand the role OTRs have played within this method of fabrication.
Objective 2: Identify 3D printing skills that would be beneficial to implement in OTR training to improve skill acquisition related to orthotic fabrication, decrease the dependency on engineering professionals, and improve widespread utilization of this fabrication method to improve patient care.

Design & Implementation

Design: A qualitative phenomenological research design was used to collect data on OTRs' experiences to understand their role within the process of fabricating 3D printed orthoses utilizing 3D printing technology.

Inclusion Criteria: OTRs who have at least three months of experience utilizing 3D printing technology and materials for orthoses within UE rehabilitation and those who are above the age 18.

Selection: A total of three OTRs were selected based on inclusion criteria.

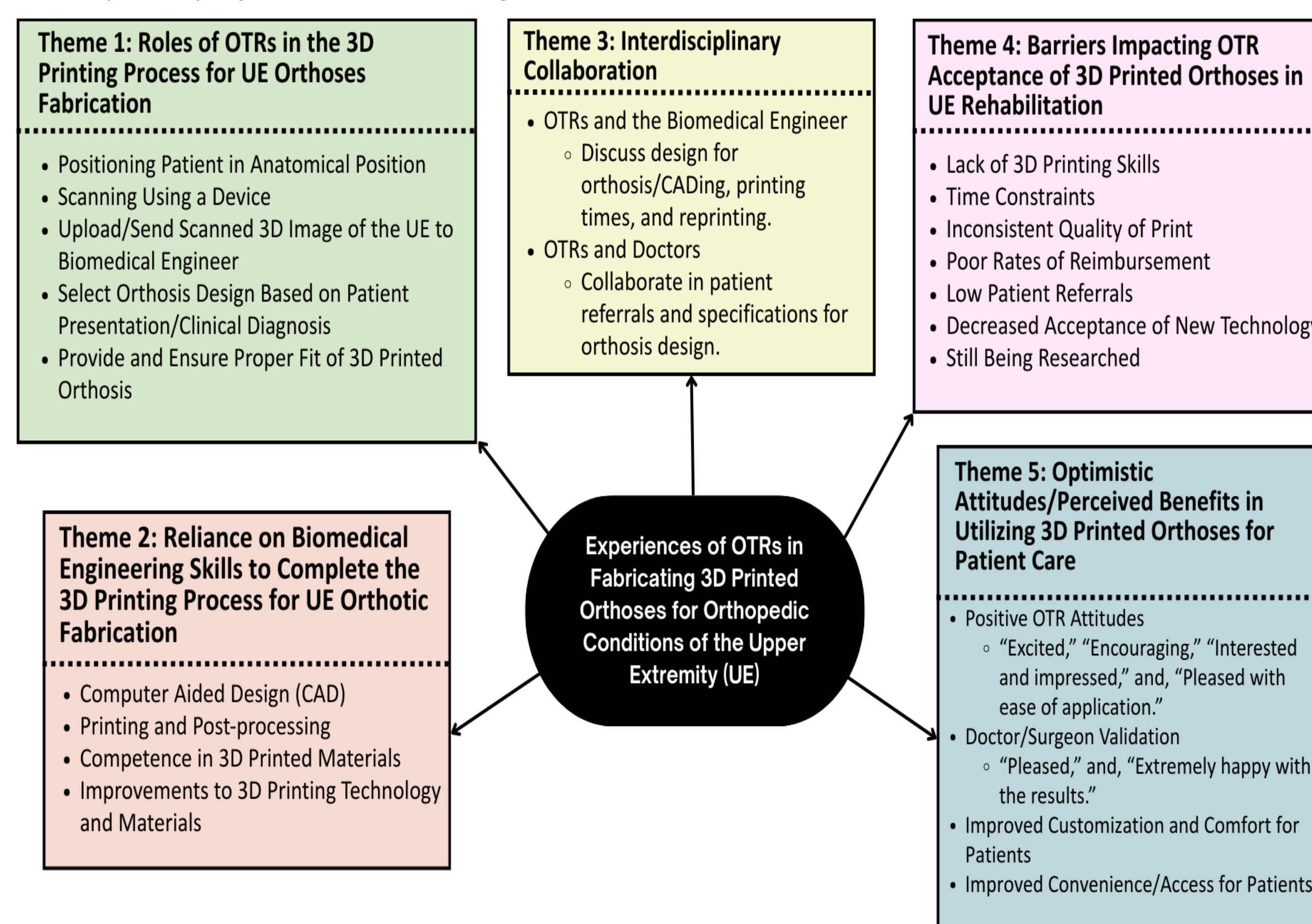
Recruitment: Participants were recruited and provided study details via email.

Implementation: Three separate semi-structured interviews were conducted during normal interactions at the capstone site. All interviews were recorded via Zoom to collect necessary data. A total of three transcripts of each participant's interview responses were also generated via Zoom and deidentified.

Data Analysis: A thematic analysis approach was used to identify themes between the participants' responses related to the research question.

Outcomes

Figure 1.
Concept Map of Interview Findings



Theoretical Basis & Significance to OT

The American Occupational Therapy Association (AOTA) has an expectation that OTRs must be competent in recent technological advancements to improve the quality of client care (AOTA, 2020; Segal & Doyle, 2023). Therefore, this project was guided by the Person-Environment-Occupation (PEO) model and the Technology Acceptance Model (TAM) to understand how the participants accepted and implemented 3D printing technology for orthotic fabrication into rehabilitative services to ensure patients are receiving updated methods of care for occupational performance. In order to improve an OTR's competence in this fabrication method, findings from this project and literature suggest the development of a training course that includes 3D printing skills of selecting 3D printing materials based on material properties, CAD, orthosis preparation for printing, printer operation, and post-processing performance is necessary (Schwartz & Schofield, 2023). If OTRs develop the listed 3D printing skills, this can improve widespread utilization of this fabrication method further providing benefits highlighted by research resulting in positive patient outcomes.

Limitations & Future Recommendations

Limitations: Small sample size impacting generalizability of findings, participant misinterpretation of interview questions, confirmation bias, and limited duration of study to determine impact of training on OTR competence and patient outcomes.

Future Recommendations: Firstly, a larger sample size will be beneficial to improve the generalizability of OTR experiences with this fabrication method. Additional use of probing questions to pilot the interview can be beneficial to utilize in the future to reduce misinterpretation of interview questions that impact responses. Reflexivity in addition to member checking and triangulation can assist in reducing subjective interpretation when analyzing participant responses to reduce confirmation bias. Lastly, more research is needed to determine if training for OTRs that includes 3D printing skills is effective in improving their overall acceptance and ability to independently complete this fabrication method. Additionally, more research is needed to determine the long-term impact 3D printed orthoses for the UE has on patient care.

Summary

This capstone project highlights the experiences of OTRs who have participated in the fabrication process of 3D printed orthoses for orthopedic conditions of the UE to determine the role they currently play and how to improve the acceptance of using this fabrication method for patient care. Based on the project results, OTRs are currently able to position patients for scanning, 3D scan, upload and send the scanned image to a biomedical engineer, collaborate on orthosis designs, provide the orthosis to patients, and ensure proper fit of the finished orthosis. However, they continue to rely on biomedical engineering professionals to complete the process as they are still deficient in 3D printing skills. Therefore, there is a need to create training for OTRs that includes all 3D printing skills to improve the adoption of this fabrication method on a large scale. Interdisciplinary collaboration, barriers, optimistic attitudes of OTRs and doctors, and experiences with patients can also be considered when determining how to improve acceptance for this technology in UE rehabilitation.

References

