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## IMPACT OF 3D PRINTING MATERIALS ON BONE PHANTOM FEATURES

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Bone drilling is a common orthopaedical procedure, where drilled hole is used for screw insertion to fix fractured bone parts. To perform successful drilling a skilled personnel is demanded, because the hole quality depends not only on the drill geometry but also cutting parameters, drilling force and drilling technique. The key issues is to drill in a way that will lead to limited generation of heat (thermal energy) to avoid osteonecrosis that occurs when blood supply for bone tissue is interrupted. To teach medical personnel the correct drilling technique a complex training is needed, including several practical attempts to drill various kinds of bones. In an ideal situation whole training should be performed on animal bones. Unfortunately from practical and economic point of view a more favourable solution is to use bone phantoms for teaching how to drill in orthopaedical procedures.

Application of bone phantoms for educational purposes is possible only, when those phantoms very well reflect the structure and properties of real bone. Thus it is necessary to produce a bone phantom that is of high quality and in the same time cost effective. One of technique that can be used for bone phantom manufacturing is 3D printing. Using 3D printing it is possible to produce short series of different bone types, that are desired by customers in certain time. Despite the undeniable advantages of 3D printing, there are several issues open avoiding the large scale production bone phantoms. Properties that have to be selected at the beginning are connected with the type of filament material that is use for printing as well as geometrical features of a final product. From the set of geometrical features most important ones are the wall thickness and type and percentage of object infill. The studies performed were connected with the selection of optimal material type and infill percentage that can be used to bone phantoms manufacturing. Phantoms were made from: nylon, PLA, and PET with different infill percentage. In order to examine and asses the quality of all phantoms an active experiment was performed. The experiment was consisted in drilling several holes in each specimen. The drilling process was assessed using IR camera. The maximal temperature in drill and bone phantom was estimated in order to find properties combination that is characterized by lowest temperature. Additionally subjective opinion of operator was took into consideration when artificial bone was compared to the real one. Obtained result shown, that there is a large difference between certain materials. It was also prove that 3D printing can be successfully applied for manufacturing of bone phantoms.