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Dead blow mallet for use in orthopedic surgeries

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In the United States alone, more than 930,000 total joint replacements (TJR) of either the knee or hip occur every year (Shmerling, 2021). These procedures can lead to major improvements in the quality of life for patients. Therefore, with an aging population, they are in high demand. For both knee and hip replacements, the surgeries require the insertion of metal rods into the neighboring bone in order to secure the artificial joint. This insertion requires a significant amount of force that is traditionally delivered through the use of a bone mallet by a trained orthopedic surgeon.

According to the American Academy of Orthopedic Surgeons, the average age of orthopedic surgeons has increased from 50.7 in 2008 to 56.5 in 2019 (Cherf, 2019). This, coupled with the findings that 44% of orthopedic surgeons reported at least one work-related injury during their career, highlights the amount of physical stress these surgeries can create for the operator (Davis et al., 2013). Therefore, it is advantageous to develop devices that can reduce stress on the surgeons while still allowing for high-impact loads.

Many heavy-weight bone mallets commercially exist for TJR surgeries, such as the ORTHOMED Orthopedic Mallet. While these mallets are the most popular tool for striking in the operating room, they do not limit recoil. Energy is lost through the strike due to recoil and as such extra stress is added to the surgeon's joints during the course of the procedures. Other newer technologies, such as the KINCISE™ which was recently FDA-approved, look to relieve surgeon stresses by replacing the handheld mallet with an automated system that delivers high-impact blows through the press of a button. However, the increased complexity of these tools can lead to increases in cost for the product. The automation also reduces the control that the surgeons have during the joint replacement process.

The Dead Blow Orthopedic Mallet was developed to limit the recoil of a strike and deliver a greater impulse per swing while keeping with the traditional-style handheld mallet. The device is made entirely of AISI 304 stainless steel and is filled with metal beads to act as particle dampers. It contains one removable cap in order to alter the number of beads within its head. The device was tested without and with the inserted beads at different concentrations to determine efficacy. This procedure included striking the prototype against a force plate sampling at 1000 Hz while the recoil was captured through video recording. The device was found effective at limiting recoil and increasing impulse delivery when containing the dampening beads.

As a result, the increase in impulse per strike would lead to fewer strikes per surgery which may result in faster operating times with decreased physical strain on the surgeons. If commercially available, this device has the potential to reduce the number of workplace injuries and increase the operating lifespan of surgeons performing TJRs. Overall, the Dead Blow Orthopedic Mallet presents a promising improvement to the field of orthopedic surgery.