3D Printing Hollow Micro-Needle Patches for Caring Terminal Cancer

Alshehri, Hala (School: Alhussan International School- Riyadh)

Pain management for terminal cancer patients often relies on opioids and invasive procedures, causing systemic side effects and psychological distress. This study developed 3D-printed hollow microneedle patches for localized, self-administered pain relief, aiming to reduce caregiver dependency and enhance patient quality of life. Microneedle prototypes were fabricated using stereolithography (SLA), optimizing parameters such as needle geometry, wall thickness, tip sharpness, and channel diameter to maximize mechanical strength, skin penetration, and drug delivery efficiency. Scanning electron microscopy (SEM) confirmed structural integrity, precise geometry, and smooth surfaces, essential for effective and safe insertion. Mechanical tests showed optimized needles effectively penetrated skin models without deformation or fracture. Two behavioral surveys assessed psychological and practical impacts. The first identified psychological distress and caregiver burden linked to traditional pain management methods. The second survey evaluated acceptance of microneedle patches among patients, doctors, and nurses in terminal cancer care. Responses indicated strong support for adoption, reflecting significant potential benefits. This interdisciplinary research highlights microneedle technology’s promise in improving pain management and psychological health, providing patient-centered solutions that promote independence and enhance quality of life.

Awards Won: