



## Comparative Overview of 3D Printing Technologies in Healthcare

<i>3D Process Type</i>	<i>Working Principle</i>	<i>Healthcare Applications</i>	<i>Advantages</i>	<i>Limitations</i>
<b><i>Powder Bed Fusion (SLS / SLM)</i></b>	Thermal energy selectively fuses powdered material inside a chamber	Medical implants, fixation devices, lattice-structured models	Small-scale technology, economical, wide range of materials	Low speed, limited size, material properties depend on powder grain
<b><i>Material Jetting (PolyJet / NJP)</i></b>	Inkjet-like deposition of material (continuous or drop-on-demand)	Anatomical models, customized dental guides and implants	High precision, low waste, multi-material and multi-color capability	Limited to polymers and waxes, requires support material
<b><i>Sheet Lamination</i></b>	Bonding of layered sheets (typically metal) via ultrasonic welding	Surgical and orthopedic models	Fast, economical, easy material handling	Limited material range, requires post-processing
<b><i>Directed Energy Deposition (DED, LMD, LENS)</i></b>	Heat source melts material during deposition, often for repair	Limited healthcare applications; repair of specific components	Rapid layer deposition, dense parts, no supports required	Limited materials, lower surface finish quality
<b><i>Vat Photopolymerization (SLA / DLP)</i></b>	Liquid photopolymer resin cured by UV or laser light	Bone structures, dental models, implant guides, hearing aids	High resolution and surface finish, complex geometries	Limited durability, UV sensitivity, not suitable for intensive use
<b><i>Material Extrusion (FDM / FFF)</i></b>	Thermoplastic extruded through heated nozzle layer by layer	Medical devices, surgical tools, prostheses	Economical, widely accessible, good structural properties (ABS)	Lower precision, nozzle-dependent quality, low speed
<b><i>Binder Jetting</i></b>	Powder layers bonded by liquid binder	Educational anatomical models, colored models	Fast fabrication, wide color range	Not ideal for structural parts, extensive cleaning/post-processing required