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Background

Three-dimensional (3D) printing is a relatively new, rapidly expanding method of manufacturing that had numerous applications in healthcare, automotive, aerospace and defense industries and in many other industries. The 3D printing has been used in the healthcare field in order to create devices that improve patient's outcomes. In occupational therapy, this technology is being used to create splints and adaptive devices that allow patients to heal and better perform tasks in their everyday life. The 3D-printing in medicine includes customised implants, and prosthetics, medical models, and medical devices that revolutionised healthcare and may even disrupt many areas of traditional medicine.

In contrast to traditional subtractive manufacturing technologies, the 3D-printing is a technique that creates objects from 3D data, usually in layer-by-layer manner using digitally controlled and operated material laying tools. Compared to the traditional manufacturing, the 3D-printing is belief to reduce material waste, shortens the fabrication period and eliminates the need for most skill-based manual operations.

This review was request to assess and analyse the benefit and issue related to 3D-printing technology for the development of prosthesis, orthosis and exoskeleton.

Objective

To assess the efficacy/effectiveness, safety and cost-effectiveness of 3D-printing for orthosis, prosthesis and exoskeleton

Methods

Literature search was conducted by an *Information Specialist* who searched for published articles on 3D-printed orthosis, prosthesis and exoskeleton. The following electronic databases were searched through the Ovid interface:

- MEDLINE® In-Process and Other Non-Indexed Citations and Ovid MEDLINE® 1946 to 31 March 2025

Other databases:

- PubMed
- Other websites: US FDA, INAHTA, CADTH, Google Scholar

Keywords: 3D-printing, orthosis, prosthesis and exoskeleton

General databases such as Google and Yahoo were used to search for additional web-based materials and information. Additional articles retrieved from reviewing the bibliographies of retrieved articles. The search was limited to articles on human and study years. There was no language limitation in the search. However, at the end only English and full text article were included.

Results and conclusion:

The review showed that, 3D-printing technology is used in healthcare especially in manufacturing 3D-printed orthosis, exoskeleton and prosthesis. The applications of those 3D-printed orthosis, exoskeleton and prosthesis varies either in musculoskeletal, custom 3D-printed implants and surgical planning/training. Although the 3D-printed orthosis, exoskeleton and prosthesis showed a potential in reducing operation and treatment time, had good accuracy and improved patient's outcome as well as increased their satisfaction; the outcomes

were depended on patient's conditions and types of the 3D-printed devices used. In terms of safety, less complications were reported with 3D-printing manufactured devices compared to conventionally manufactured. However, there are concerns on failure/malfunction and breaking issues. Other concerns were related to organisational issues which were production time, choice of materials, patient's conditions which might affect the data collections such as image taking or molding process, expert personnel both in printing process and medical expertise, lastly the production capacity especially for mass production.

The cost-effectiveness for 3D-printed orthosis, exoskeleton and prosthesis could not be determining as it depended on types of 3D-printed device to be manufactured, the whole manufacturing process involved included the raw materials cost as well as the 3D-printer which had different price range.