FutureFeet

4.Discussion

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1 Discussion

Orthoses were used during much of recorded history[1,2]. During the 20th century, the evolution of industrial manufacturing processes has significantly influenced the way FO have been made[3–20]. In the 1930s, the development of the thermoforming process significantly influenced the innovation in the field of FO[3,4,13–17]. In 1958, Root was one of first to experiment the vacuum forming techniques with thermoplastics [3] and his Root Functional orthoses theory has been followed by other FOs such as the UC-BL [4], the Blake Inverted Orthosis [13–15] and the medial heel skive[16]. In the 1980's, the subtractive manufacturing technique was introduced in the FO field [18], approximately 30 years after the first commercial numerical-control programming system had been developed [19]. Once more, the development of a manufacturing technique significantly influenced the innovation in the FO field [19]. To date, the most recent manufacturing method which has been implemented in the FO field is the additive manufacturing (AM)[5–12,20]. It is recognised that the digital manufacturing process provides a lot of opportunities such as a potentially increased accuracy of the product manufactured[21–23] and the ability to better embrace the concept of dosage response modelling [24–34]. However, the potential of the digital manufacturing process has not yet been sufficiently explored in the field of orthotics [35] which could be explained by the fact that some barriers to its proper implementation persist[35–39].

The evolution in the design and manufacturing of FO has inevitably led to an adaptation of the skills of foot health practitioners [3,4,13–17,22,40,41]. At this time, the latest developments in the design and manufacture of FO have been made possible thanks to technological advances [5–12,18–20]. Since these technologies are still evolving a lot [21,42–44], it is highly probable that their implication in FO intervention is at an early stage [45–49]. However, it is believed that their potential added value lies in their ability to produce parts with high level of customisation and geometric complexity without impacting their costs [22] and in their potential to make FO with new functionalities [9,21–23,35,46,48–57].

Whereas the innovative technologies provide some promising opportunities to add value to the FO intervention, the foot health practitioner should keep in mind that this value should always be defined around the patient [59]. The concept of creating value in the domain of healthcare originates from the business world where it is suggested that value of a product or service should always be defined around the customer [59,60]. Since people are increasingly requiring more environmentally responsible products [62], our consortium of experts in the field of FO suggest that the value of a FO intervention can be subdivided into economic, ecological and experience value [59,60]. Based on this, it can be considered that a FO intervention is appropriate for a patient as long as it can create the economic, ecological and experience values which have been defined around that patient [59,60].

While different FO interventions could be appropriate for a specific patient [63] there is currently a lack of data specific to FO intervention which could guide the clinical decision making. To address this problem, some research has newly introduced a concept originating from the pharmaceutical industry [27] which analyse how incrementally modifying certain parameters/features of the FO (dose of stimulus) impact a variable observed (response) [12,17–20]. Facilitating the accurate replication of FO analysed in those research within clinical practice would allow a less subjective implementation of the dosage-response modelling concept. In this perspective, some efforts have been made in this paper to take full advantage of the ability of computer-assisted techniques to replicate accurately a FO [64,65]. Firstly, a new terminology was introduced with the objective to promote a common and adequate description of the inputs and their protocol of acquisition. Secondly, this paper encourages the use of CAD systems in which a mathematical foundation determines how the FO geometry behave when certain features are changed[66–71]. Sharing these mathematical foundations would provide the opportunity to reproduce a specific FO geometry modification [64,66,70]. Thirdly, the geometric design process, the material design process and the manufacturing process used should also be communicated in order to give the ability to replicate them [72–74]. By sharing this information in their studies, researchers would promote a more cautious replication of the FO they have investigated and could therefore guide the creation of value of FO intervention in the clinic. In the future, the use of computerised clinical decision support systems is also a promising opportunity to guide the foot health practitioner in the creation of value of FO intervention [75].

This work has, among other things, highlighted how the field of foot orthotics has been influenced and inspired by certain advances and concepts in other fields such as engineering, business, and pharmacology. In addition, this work put forward that the implication of technologies in FO intervention are still at an early stage but their ability to produce parts with high level of customisation and geometric complexity without impacting their costs and their potential to make FO with new functionalities are promising. Aside from the fact that these technologies bring great opportunities in the field of FO, practitioners should keep in mind that their use can only be considered as appropriate when it creates value for the patient.

2 Reference

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