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Case study: Including 3D printing in prosthetic fabrication for young children

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Additive manufacturing (AM) and traditional craftsmanship are increasingly combined in pediatric prosthetics to address challenges of growth-related variability, individualized fit, and user comfort. This case study covers 3 pediatric patients with lower limb deficiencies provided with prosthetics over a span of up to 4 years. Each case involved the integration of 3D-printed components – primarily sockets, prosthetic feet, interface components and design elements – produced using fused deposition modeling (FDM) and selective laser sintering (SLS), combined with handcrafted modules such as cushion elements and length adjusting shims. Rather than advocating a shift to purely additive techniques, we highlight a modular, hybrid approach. This includes both fully digital pathways and analog-to-digital transitions or vice versa.

The result is a patient-specific workflow that adapts flexibly to clinical requirements and technical constraints. Qualitative evaluations were conducted, including functional assessments (e.g., donning issues, gait pattern, integration into daily life) and caregiver-reported satisfaction. Outcomes showed improved prosthetic acceptance and fewer adjustments. These findings are consistent with previous studies on user experience and fit precision in AM-based devices [1-3]. However, limitations such as regulatory ambiguity, cost of entry, and size constraints in AM persist. Moreover, pediatric use cases demand frequent remakes due to rapid somatic growth, which may counterbalance long-term cost-efficiency [4].

By aligning this practice-based report with branch-specific discussions on reproducibility and personalization in medical AM [5], we demonstrate how hybrid workflows can serve as a scalable strategy. Clinics and prosthetists can replicate this approach to enhance patient care without loss of knowhow that is often supported by commercially available full digital solutions, thus enabling innovative and reliable optimization in pediatric care.

AUTHOR'S STATEMENT

Conflict of interest: The authors are managing directors and owners of LiEBAU Orthopädietechnik GmbH. Animal models: Not applicable. Informed consent: Informed consent has been obtained from all individuals included in this study. Ethical approval: Not applicable. Acknowledgments: The authors would like to express their sincere gratitude to Prof. Dr. med. W. Mittelmeier and Prof. Dr. med. C. Lutter from the University Medicine Rostock, Orthopedic Clinic and Polyclinic, for their continuous collaboration and guidance. The development of such prosthetic solutions would not be possible without their dedicated support and expertise. Research funding: The authors state no funding involved.

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