INTRODUCTION

Documentation of pediatric partial foot amputation (PFA), prosthetic intervention and effectiveness of treatment is insufficient. However, recommendations regarding pediatric prosthetic intervention advise downsizing, sequenced complexity and a modular design that does not interfere with an increased activity level. In the general population PFA is the most common amputation surgery with 2 per 1000 affected. Transmetatarsal or mid-tarsal amputations account for approximately 24% of PFAs. In the pediatric population 40% of amputations are attributed to trauma. Lawn mowers and household accidents account for the majority of the partial foot amputations in the pediatric population. Current pediatric treatment options mimic those for adults with the extent of the intervention proportional to the extent of tissue lost. More recently it has been recommended that any amputation involving the metatarsal heads or proximal structures requires a prosthetic intervention that extends proximal to the ankle. A prosthesis utilizing a custom fit rigid dynamic carbon composite (DCC) ankle foot orthosis structure to aid in the restoration of gait has been proposed for the adult PFA patient. By extending above the ankle the prosthesis aids in the progression of the center of pressure along the foot and restores the biomechanics of walking.

METHODS

A prosthetic design for treating the pediatric partial foot amputee that restores gait function by addressing the biomechanical deficits is proposed. A custom fit rigid DCC with carbon anterior shell AFO customized with a toe-filler type socket with wedging, lifts and posting are the components of the proposed prosthesis. Until recently there was not a custom fit option for providing a reliable custom fit rigid DCC structure in which to fabricate a custom prosthesis for the pediatric population. The new custom fit rigid DCC is a prefabricated full carbon foot plate, rigid lateral strut and carbon composite anterior shell. The footplate is rigid with a tapered rocker built into the distal section with a flexible posterior section and a rigid stable midfoot. This design aids in restoring gait by allowing for a controlled plantarflexion moment at initial contact, a stable midstance and a controlled tibial advancement through terminal stance, while maintaining a 3rd rocker rollover and providing propulsion at terminal stance. This system is combined with a custom molded toe filler type prosthesis that is aligned with wedges, posts and lifts to maximize functional outcomes. This system addresses the biomechanical deficits of the PFA and the DCC is designed to have varying degrees dynamic function by style and size. The ability to customize the socket, alignment and interface helps to protect the skin of the residuum while the dynamic function can be customized for functional needs.

RESULTS

The pediatric prosthetic design is proposed based on the outcomes of the adult treatment option with similar outcomes expected. This prosthetic design has been used with adult PFA patients since 2010 the anecdotal results are positive. Patients report increased mobility and decreased skin breakdown.

DISCUSSION

Research on specific effects on gait function utilizing the proposed PFA DCC design need to be conducted. Preliminary data regarding use of the DCC AFO in the pediatric population indicates that a dynamic response carbon AFO, similar to the rigid DCC design, provides improved function in running, jumping and walking performance while Gross Motor Function Measure was also improved. Similar outcomes are expected with a PFA DCC prosthesis due to the similarity of the gross structure and function of the rigid DCC design.

REFERENCES

2. Cummings, DR & Kapp, SL. JPO; V4, N4, 196, 1992.
3. Dillon, M. O&P Edge; February 2010.

DISCLOSURE

Vincent DeCataldo, BOCPO, NJ LPO is employed by Allard USA manufacturer of dynamic carbon composite AFOs.