



### PROJECT COMPLETION REPORT

1. **Project Number** : P 7448
2. **Title of the Project** : Structural performance assessment of FUPRO grace foot
3. **Funding Agency Name** : Industry consultancy and sponsored research. Funded by M/s. FUPRO Innovations Pvt Ltd.
4. **Project Reference Number provided by the Funding Agency:**  
DTL DTS 012 is the reference of mutual agreed study plan.
5. **Principal Investigator (Name & Address):**

Sl. No	Name	Role	Address
1	Subhash N. N.	Study Investigator	Scientist/Engineer C Division of Artificial Internal Organs, DMDE, BMT Wing, SCTIMST
2	Muraleedharan C. V.	Study Director	Scientist G (Sr. Grade) Division of Artificial Internal Organs, DMDE, BMT Wing, SCTIMST

6. **Co-Investigators (Name & Address):** Nil
7. **Implementing Institution** : SCTIMST along with industry partners
8. **Collaborating Institutions** : M/s FUPRO Innovation Pvt Ltd is the Industry partner
9. **Date of Commencement** : 26/02/2021
10. **Duration** : 26/02/2021 to 02/11/2022
11. **Date of Completion** : 02/11/2022
12. **Objectives as approved:**

Sl. No	Objective	Industry Partner	Commercialized Products
1	To assess the structural performance of FUPRO Grace Foot by performing 1. Static proof test 2. Static ultimate strength test of fore foot	M/s FUPRO Innovation Pvt Ltd	Grace Foot

	3. Static ultimate strength test of heel		
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13. Deviation made from original objectives if any, while implementing the project and reasons thereof :  
Nil

14. Field/Experimental work giving full details of summary of methods adopted, data collected supported by necessary tables, charts, diagrams and photographs :

Grace foot is a unique prosthetic foot commercialised by M/s FUPRO Innovation Private Ltd and is commercially available in the market. This bioinspired prosthetic foot is designed for K2-K3 level amputees and mimics the natural movement of the ankle. This project investigates the natural frequencies and mode shapes of the Grace Foot design using modal analysis, and the static structural analysis under the action of external stimulus (static and ultimate loads at heel and forefoot) as per ISO 22675, Testing of ankle-foot devices and foot units. Static analysis were verified with in vitro test.

More details may be referred from the published work given below

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

Figures from published work are given below.

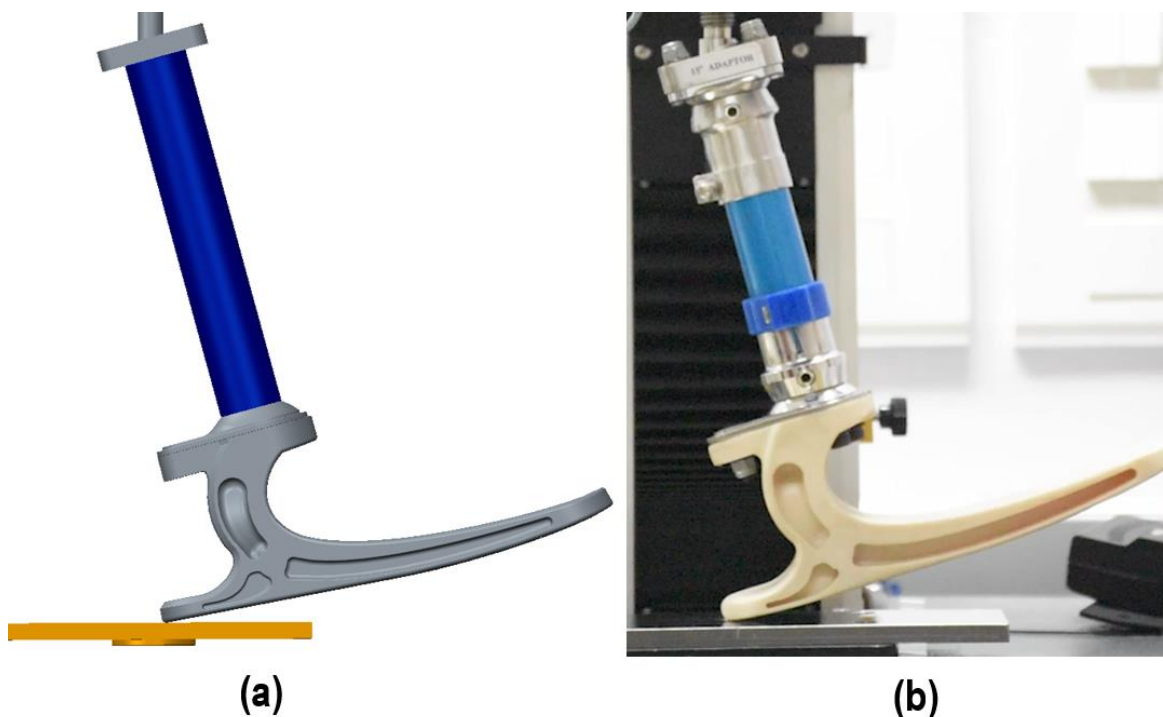


Figure 1: FUPRO Grace foot (a) 3D model (b) Industrial Prototype

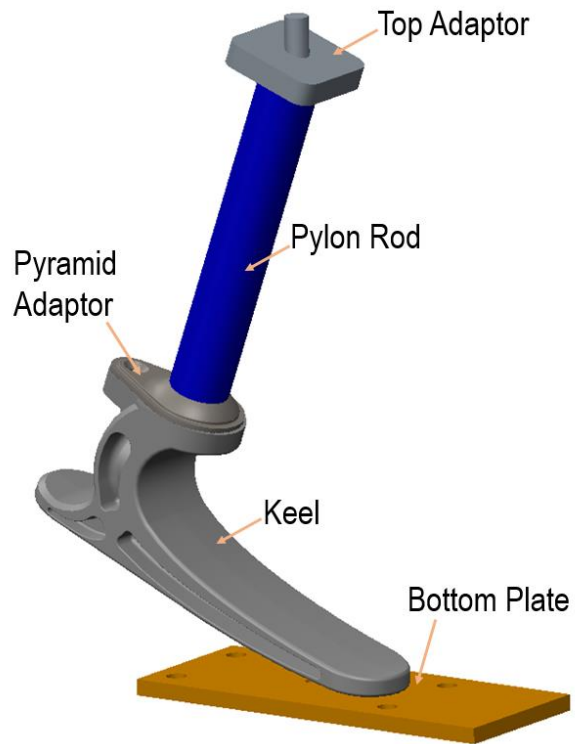


Figure 2: Components of the Grace foot



(a)



(b)

Figure 3: Experimental testing of FUPRO foot in (a) heel and (b) forefoot configuration in INSTRON 3345 UTM. This inhouse test system is used to verify the finite element models and qualify the device as per standards.

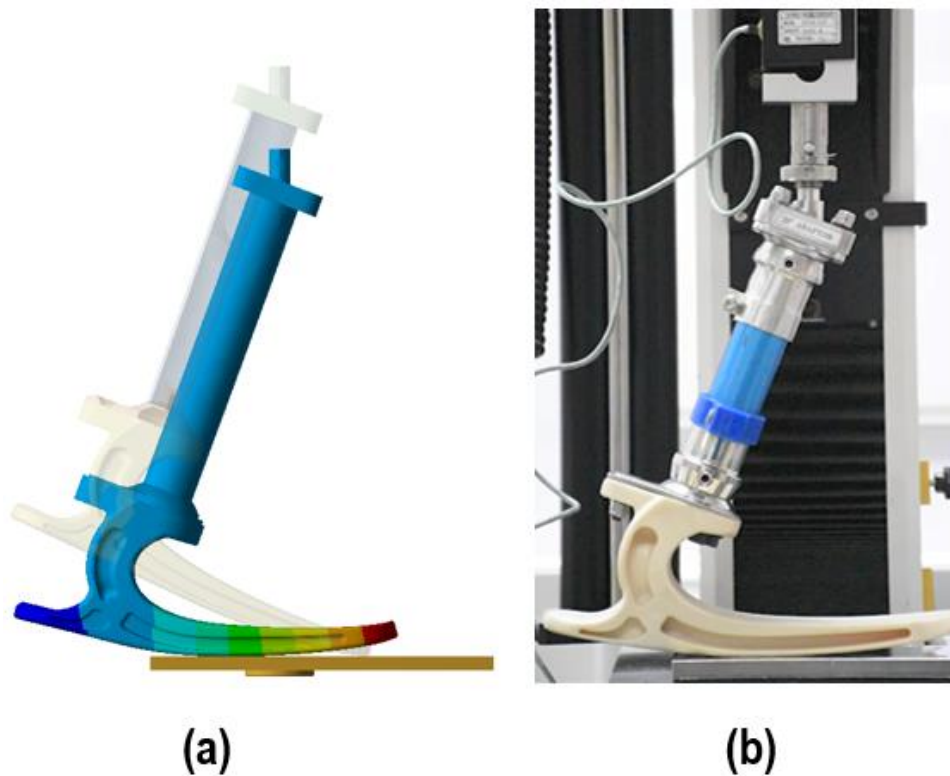


Figure 4. Deformation of device in static ultimate case (a) FEA results (b) in vitro tests. The deformation contour predicted by the FEA closely resembles with the in vitro test.

**15. Detailed analysis of results :**

Details may be referred from the published work given below

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

**16. Summary sheet of not more than 2 pages under following heads:  
(Title, Introduction, Rationale, Objectives, Methodology, Results, Translational Potential)**

Details may be referred from the published work given below

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

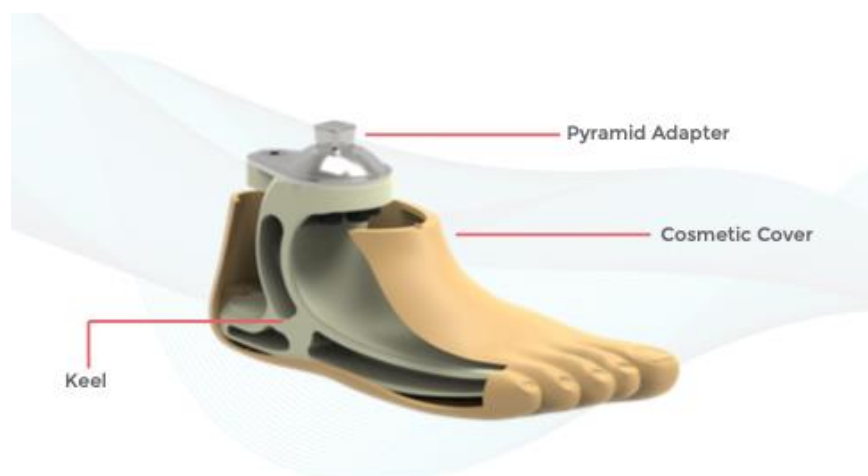
**17. Contributions made towards increasing the state of knowledge in the subject :**

Details may be referred from the published work given below

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

**18. Conclusions summarising the achievements and indication of scope for future work :**

The Industry partner has communicated the commercialization details to Technology Business Division through email and acknowledged the efforts of SCTIMST team for the successful collaboration.



### Specifications

Weight*	593 grams
Build Height*	100 mm
Activity Level	K2-K3
Body Weight Class	<64 / 64-84 / 84-104 Kgs
Sizes	24,25,26 cms
Warranty**	24 months on keel, 6 months on Cosmetic Cover

\* For size 25 (64-84kgs) with Cosmetic Cover

Figure 5. Specifications. Courtesy: FUPRO Grace foot marketing brochure

**19. Science and Technology benefits accrued :**

**a. List of research publications with complete details :**

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

**b. Manpower trained on the project :**

- i. Research Scientists or Research Fellows : Nil
- ii. No. of PhD's produced : Nil
- iii. Other Technical Personnel trained : Nil

**c. Patents taken, if any : Not Applicable**

**d. Products developed, if any : Products commercialised by industry partner M/s FUPRO Innovation Pvt Ltd is "Grace Foot"**

**20. Abstract: (In 300 words for possible publication in ..... Bulletin)**

Details may be referred from the published work given below

- Subhash NN, Mehra N, Choudhary A, Baby CJ, Aravind AU, Benny P, Muraleedharan CV. Structural Performance Assessment of FUPRO Grace Foot. Trends in Biomaterials & Artificial Organs. 2022 May 17;36(2):94-101.

21. Procurement/Usage of Equipment:

a. Details of Equipment:

Sl. No.	Name of Equipment	Make/ Model	Cost (Rs.)	Date of Installation	Utilisation	Remarks regarding maintenance breakdown
1	Nil					

b. Suggestions for disposal of equipment(s):

Not applicable



Subhash N. N.

9 Nov 2023

(Name and Signature of PIs with date)

**Routing:** Signed copy of "Project completion Report" by PI → [root@sctimst.ac.in](mailto:root@sctimst.ac.in), [rpc@sctimst.ac.in](mailto:rpc@sctimst.ac.in)