

<Supplementary material>

We performed an experiment to measure the maximum active torque on the test bench. The experimental environment was set up as shown in Figure S1A. Figure S1B depicts a free body diagram based on the center of the knee joint. The active torque of our prosthesis for lifting the barbell is expressed as in Equation S1, and the values of each variable are shown in Table S1.

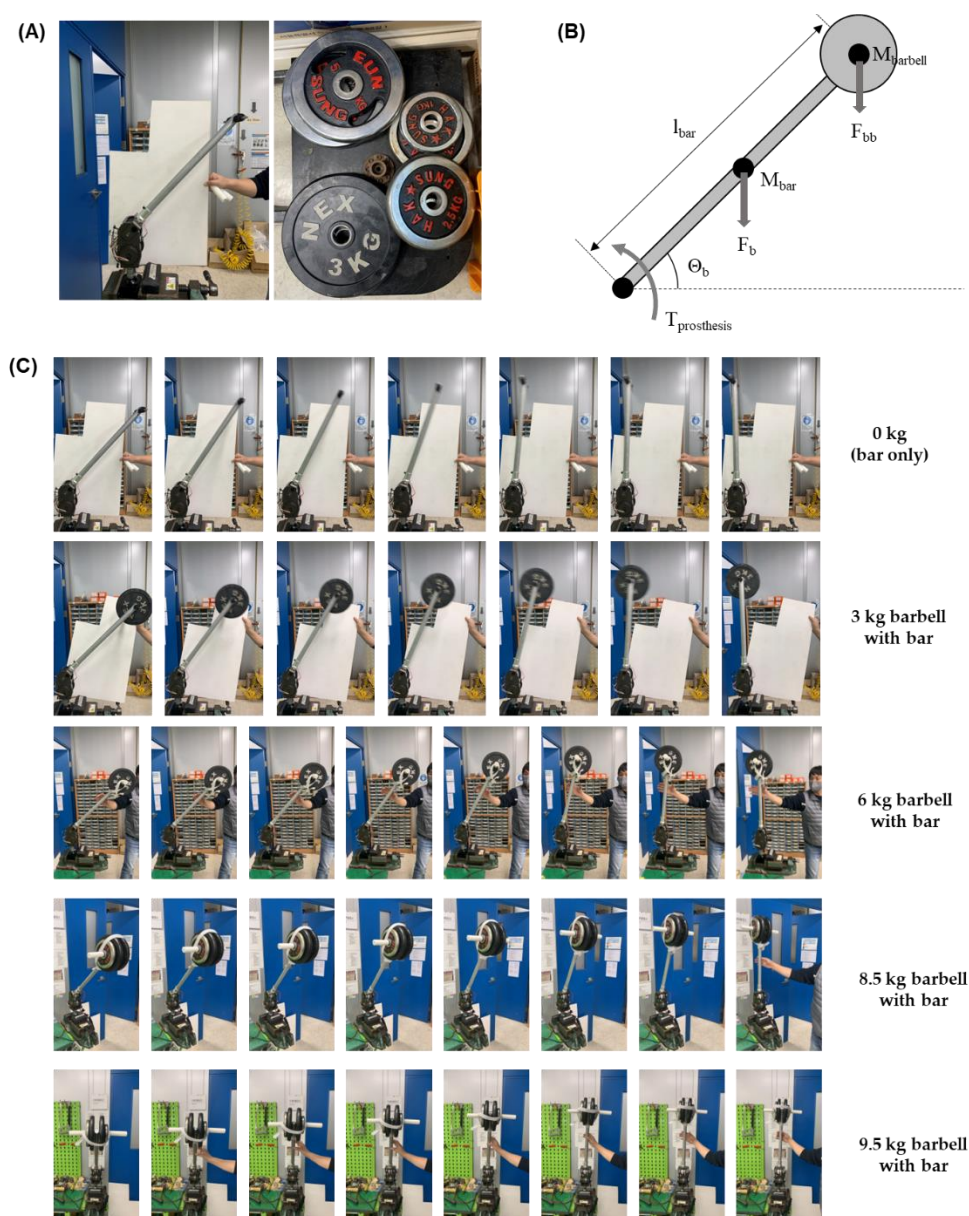


Figure S1. (A) Experimental setup to measure the maximum active torque on the test bench; (B) Free body diagram based on the center of the knee joint in test bench; (C) The babel lift test: the ability of the active drive to provide active torque to the joint.

Table S1. The parameters of the active torque measurement

Symbol	Value	Description
m_{bb}	Variable	Mass of barbell

$T_{\text{prosthesis}}$	Variable	Active torque of the hybrid prosthesis
m_b	1.5 kg	Mass of bar
l_b	0.6 m	Length of bar
θ_b	45°	Initial angle

$$T_{\text{prosthesis}} = F_b \cdot \frac{l_b}{2} \cdot \cos \theta_b + F_{bb} \cdot l_b \cdot \cos \theta_b \quad \text{-----} \quad \text{Equation. S1}$$

We measured the maximum torque that our prosthesis could generate while increasing the weight of the barbell, as shown in Figure S1C. Finally, our prosthetic knee lifted a 9.5Kg barbell, and the torque was measured to be 42.1 Nm during this time. In the future, we plan alter the gear ratio of the upper and lower pulleys as well as the harmonic gear with a high gear ratio, making it possible to construct a prosthesis most appropriate for the active walking of amputees.