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DEVELOPMENT OF ADVANCED ELASTOMER COMPOSITES FOR PROSTHETIC LINERS

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The global incidence of lower-limb amputations has shown a persistent and escalating trend over the past five years. Annually, over 80% of all amputations worldwide are attributed to chronic, lifestyle-related conditions such as diabetes mellitus and peripheral vascular disease [1]. This demographic alone means that millions of patients require immediate, high-quality prosthetic care. However, recent global events have introduced a devastating and rapidly growing surge in traumatic amputations. Modern armed conflicts have created a unique cohort of patients whose injuries, often involving complex blast trauma, necessitate prosthetic devices that meet unprecedented standards of durability, comfort, and functionality.

This urgency is most acutely manifested in Ukraine, where the full-scale invasion since 2022 has resulted in a critical public health crisis concerning war-related limb loss [2]. The magnitude of the situation necessitates a data-driven approach. While precise final figures remain challenging to ascertain during active conflict, reputable sources and international medical consortia estimate that tens of thousands of military personnel and civilians have suffered partial or complete limb loss since February 2022. This figure dramatically outweighs the pre-war incidence, establishing an unprecedented need for prosthetic rehabilitation in the country. Critically, the vast majority of these injuries (>70%) are the result of blast trauma (mines, artillery, rockets), leading to a specific clinical profile like complex tissue damage, demanding materials that are highly compliant and protective [3]. Additionally, a significant proportion of the patient cohort comprises young, active individuals who require prosthetic devices that can withstand intense, prolonged mechanical stress.

This distinct trauma profile is fundamentally different from the diabetic etiology prevalent globally and demands materials that can withstand high mechanical stress while providing superior protection to the compromised residual limb [4]. Addressing this national priority requires a radical re-evaluation of current prosthetic technologies, pushing the boundaries of materials science to develop solutions that support long-term patient mobility and rehabilitation.

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