

RÉPUBLIQUE ALGÉRIENNE DÉMOCRATIQUE ET POPULAIRE
MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA
RECHERCHE SCIENTIFIQUE
ÉCOLE NATIONALE POLYTECHNIQUE



Département de Génie Mécanique
Laboratory of Green and Mechanical Development (LGMD)

Final Year Project Thesis

To obtain the State Engineer degree in Mechanical Engineering

Design and Fabrication of a Femoral Prosthesis for Clinical Testing

ZERKOUK Riadh & TOUATI Amine

Under the supervision of **Dr. BELOUADAH Zouheyr**, ENP

Presented and publicly defended on (07/07/2025)

Jury Members:

President:	M. BELKACEMI Yacine	MCA ENP
Supervisor:	M. BELOUADAH Zouheyr	MCA ENP
Examiner:	M. SEDJAL Hamid	MAA ENP

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Département de Génie Mécanique
Laboratoire de Développement Durable et Mécanique (LGMD)

Mémoire de Projet de Fin d'Études

Pour l'obtention du diplôme d'Ingénieur d'État en Génie Mécanique

Conception et Fabrication d'une Prothèse Fémorale pour Essais
Cliniques

ZERKOUK Riadh & TOUATI Amine

Sous la direction de **Dr. BELOUADAH Zouheyr**, ENP

Présenté et soutenu publiquement le (07/07/2025)

Membres du Jury :

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المخلص: تصميم وتصنيع طرف صناعي فخذي من أجل اختبارات سريرية

تُشكّل البتر فوق الركبة (البتر الفخذي) تحديات كبيرة في مجال التأهيل باستخدام الأطراف الصناعية، لا سيما في تصميم الجُويّات (emboîtures) التي توفر الراحة والوظيفة في آن واحد. من بين المشاكل الشائعة: الألم، وسوء التوافق، وضعف التثبيت، بالإضافة إلى التوزيع غير المعروف للضغط داخل الجُويّة. غالبًا ما يتم وضع مناطق التعزيز دون بيانات موضوعية، مما قد يؤثر سلبيًا على الراحة والمتانة.

يهدف هذا المشروع إلى فهم أفضل للتفاعل بين الجزء المتبقي من الطرف المبتور والجُويّة. من خلال تحديد مناطق الضغط الحرجة وتقييم سلوك الجُويّة، يسعى المشروع إلى تحسين الراحة، والتوافق، والأداء العام. الهدف النهائي هو المساهمة في تصميم أكثر كفاءة وتخصيصًا للجُويّات الخاصة بمبتوري الأطراف الفخذية.

الكلمات المفتاحية: جُويّة فخذية، أخذ القياسات، قوة الضغط، الطباعة ثلاثية الأبعاد، التوصيف الميكانيكي.

Résumé: Conception et fabrication d'une prothèse fémorale pour des essais cliniques.

L'amputation transfémorale présente d'importants défis en matière de réhabilitation prothétique, notamment dans la conception d'emboîtures à la fois confortables et fonctionnelles. Les problèmes fréquents incluent la douleur, un mauvais ajustement, un accrochage insuffisant et une répartition des pressions mal connue à l'intérieur de l'emboîture. Les zones de renfort sont souvent placées sans données objectives, ce qui peut nuire au confort et à la durabilité. Ce projet vise à mieux comprendre l'interaction entre le membre résiduel et l'emboîture. En identifiant les zones de pression critiques et en évaluant le comportement de l'emboîture, il cherche à améliorer le confort, l'ajustement et la performance globale. L'objectif final est de contribuer à une conception plus efficace et personnalisée des emboîtures pour les amputés transfémoraux.

Mots-clés: Emboîture fémorale, prise de mesures, force de pression, impression 3D, caractérisation mécanique.

Abstract: Design and Fabrication of a Femoral Prosthesis for Clinical Testing

Transfemoral amputation presents major challenges in prosthetic rehabilitation, especially in designing sockets that are both comfortable and functional. Common issues include pain, poor fit, inadequate suspension, and unclear pressure distribution inside the socket. Reinforcement zones are often placed without objective data, which can affect both comfort and durability. This project aims to better understand the interaction between the residual limb and the socket. By identifying critical pressure areas and assessing socket behavior, it seeks to improve comfort, fit, and overall performance. The ultimate goal is to contribute to more effective and personalized socket design for transfemoral amputees.

Keywords: Femoral socket, measurement acquisition, pressure force, 3D printing, mechanical characterization.

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ZERKOUK Riadh and TOUATI Amine

Dedication

To my family

*To my beloved **mother, father, and older brother:***

Thank you from the bottom of my heart for your unconditional support, your countless sacrifices, and your presence through every step of my life in both joyful and difficult times. Without your love, guidance, and encouragement, reaching this point would have been far more challenging, if not impossible.

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And finally —

As they say, the best is always saved for last.

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Dedication

To my family —

*To my dear **father and mother**,*

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To my beloved siblings —

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