Proximal tibia osteotomy: Biomechanics study of two techniques

Journal of Orthopaedic Surgery • Article • *Open Access* • 2025 • DOI: 10.1177/10225536251369145

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Abstract

Introduction: Proximal tibia osteotomy has advanced with various techniques, such as dome and modified oblique osteotomies, to correct angular deformities and redistribute knee stress, thereby slowing arthritic progression. Despite advancements, a gap remains in understanding the biomechanical strengths of these techniques, especially concerning correction angles. The study aims to compare the stability of the construct for different degrees of osteotomy. Materials and methods: Eighteen synthetic tibias were osteotomised based on the dome and modified oblique osteotomy technique. For dome osteotomy, the osteotomy site was fixed with two Kirschner wires 2.0 mm for different degrees of osteotomy, which were 10^{o}, 20^{o}, and 30^{o}. Three samples from each construct were tested for rotational force. For modified osteotomy, two screws 3.5 mm were used to fix the osteotomy site and tested for rotational forces. Results: The constructs were stiffest at ten degrees for rotational force, both in dome and modified oblique osteotomy (0.39 Nmm and 0.4 Nmm). The stiffness of dome osteotomy in correction angles of 10° and 20° is almost similar ($p > 0.95$), and it reduces significantly at 30°($p < 0.001$). There were significant differences in stiffness of the oblique osteotomy construct when comparing 10° with 20° ($p = 0.003$), 10° with 30°($p < 0.001$) and 20° with 30° ($p < 0.001$) correction angles. This is further proved by comparing the means of stiffness between the two methods, where dome osteotomy did better compared to modified oblique osteotomy at 20° and similar at 10°. Conclusion: In performing proximal tibia osteotomy, we recommend limiting the acute angle of correction to 20°, and we suggest that for a larger correction angle, dome osteotomy exhibits better biomechanical stiffness. An angle exceeding 30^{o}will predispose to higher rate of non-union or malunion as the stiffness of the surgical construct drops significantly, making it less resistant to rotational forces.

Author keywords

dome osteotomy; modified oblique osteotomy; osteotomy; rotational force

Indexed keywords

MeSH

Biomechanical Phenomena; Bone Wires; Humans; Osteotomy; Tibia

EMTREE medical terms

Article; biomechanics; Blount disease; decision making; dome osteotomy; high tibial osteotomy; human; osteotomy; quality of life; tibial tuberosity; biomechanics; bone wire; comparative study; osteotomy; procedures; surgery; tibia

Device trade names

Commercial names given to devices, used for branding and differentiation in the market, commonly referenced in scientific and clinical research.

Tradename	Country	Manufacturer
WP500 Torsion Testing Apparatus	Germany	GUNT Hamburg Geratebau GmbH

Tradename	Country	Manufacturer
IBM SPSS Statistics version 27.0		IBM

Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

Funding sponsor	Funding number	Acronym
UMPSA		
Universiti Malaysia Pahang See opportunities by UMP		UMP
Sultan Ahmad Shah Medical Centre @ IIUM		
International Islamic University Malaysia See opportunities by IIUM	RMCG20-025-0025	IIUM
International Islamic University Malaysia See opportunities by IIUM		IIUM

Funding text 1
The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by Research Management Grant, International Islamic University Malaysia (Grant no. RMCG20-025-0025). We would like to extend our sincere gratitude to the staff at the Orthopaedic Research Laboratory, IIUM and Sultan Ahmad Shah Medical Centre @ IIUM (SASMEC@IIUM) for their invaluable assistance and support throughout this research project. Furthermore, we appreciate the support and technical assistance provided by the staff at the Mechanical Engineering Laboratory of Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA), Gambang, which significantly contributed to the successful completion of this research.

Funding text 2
The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by Research Management Grant, International Islamic University Malaysia (Grant no. RMCG20-025-0025).

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