

Obesity and orthopedic implant treatment: case report and biomechanical analysis

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The number of overweight and obese patients in developed countries is gradually increasing. It was reported that 1287 (64%) out of 2007 adults operated on in 2017 had a body mass index (BMI) greater than 25 kg/m², and 26.4% even greater than 30, while the BMI of the most obese patient was as high as 57.6 kg/m². Such distressing statistics raised an issue related to the inadequate durability of implants used for the fixation of bone fractures. Implants for the lower-extremity fractures may not be durable enough to fit the requirements of overweight and obese patients.

This case report presents the history of a 23-year-old obese male with a BMI of 38.7, who bent the angularly stable titanium plate stabilizing his broken lateral ankle and torn distal tibiofibular syndesmosis. Biomechanical analysis showed that the maximal static bending moment registered during one-leg standing was equal to 1.55 Nm. This value was circa one-third of the maximally admissible bending moment for this particular plate (5.34 Nm) that could be transmitted without its plastic deformation. Since dynamic forces exceed static ones several (3–12) times during typical activities, such as walking, climbing the stairs, running, and jumping, unpredictable forces may occur and increase the risk of loosening, bending, and even breaking implants. None of these situations should have occurred for the typical patient's body mass of 75 kg, or even for the analyzed mass of the young patient (120 kg) who tried to avoid excessive loading during his daily routine. Subsequent implant bending and destabilization of the fracture shows that for the significantly high and still growing number of obese patients, a very strict physical regime should be recommended to prevent overabundant dynamic loads.

Implants for lower-extremity fractures may not be durable enough to fit the requirements of overweight and obese patients, since mechanical forces and their moments generated during body weight bearing may exceed the commonly tolerated limit values. To minimize the risk of complications in cases of physically active and insubordinate obese patients, an additional lower-limb immobilization in a plaster cast may be justified. The design of more durable implants for obese and highly active patients should also be taken into consideration in the form of implants' adaptations to the real requirements.

References:

[1] Szczęsny, G., Kopec, M., Szolc, T., Kowalewski, Z.L., Małydyk, P., Deformation of the Titanium Plate Stabilizing the Lateral Ankle Fracture Due to Its Overloading in Case of the Young, Obese Patient: Case Report Including the Biomechanical Analysis. *Diagnostics*, 2022, 12, 1479, pp. 1-10