Aseptic loosening is one of the main reasons for the revision of a total knee replacement (TKR). The design of the key component of a TKR, the femoral component, is particularly problematic because its failure can be the result of different causes. This makes the development of new biomaterials for use in the femoral component a challenging task. This paper focuses on the engineering design aspects in order to understand the limitations of current materials and design deficiencies. The paper describes the introduction of a new biomaterial for a femoral component and justifies the recommendation to use multifunctional materials as a possible solution to aseptic loosening. The potential advantages of applying functionally graded biomaterials (FGBMs) in prosthetic femur are explained by reducing the leading causes of failure including wear, micro-motion and stress-shielding effect. The ideas presented in this paper can be used as the basis for further research on the feasibility and advantages of applying FGBM in other superior implant designs.

**Keyword:** Knee prosthesis; Biomaterials; Functionally graded materials; Composites; Selection for material properties; Engineering design