



Letter to the Editor

**External fixation of the lower extremities:
Constantly striving for the best results**


With great interest we read the article about external fixation of the lower extremities by Bliven et al. [1]. In this article the authors describe biomechanical properties and possible innovations in external fixation osteosynthesis for fracture treatment and three-dimensional corrections of bony deformities.

The authors stated that instability at the fracture site is an issue that has been addressed by continuous modifications and new developments of external fixator devices, for example hexapods and even octapods that both are dependent on specialized computer software and CT data.

Gavriil Abramovich Ilizarov (1921–1992) made callus distraction for bone lengthening a safe and successful procedure [2,3]. He had good clinical results and in histological analyzes he found best and fastest bone tissue formation via intramembranous ossification during callus distraction using his ring fixator, which allows a quasi-static distraction with much less shear forces compared to unilateral external fixators [4].

In contrast, the advantages of unilateral fixators over ring fixators are that they are easier to mount and more comfortable for the patients, but with these devices even in callus distraction shear forces hinder direct bone formation via intramembranous ossification and instead lead to a high amount of endochondral ossification even under the mechanical conditions of tension stress in distraction osteogenesis [4,5].

Later, different research groups verified the negative effect of shear forces on bone healing in general [6–10].

In 2009 Seybold et al. reported about their analyzes of hexapods and especially Taylor Spatial Frames and emphasized that these devices have an intrinsic instability, which in the complex construct of hexapods is necessary in order to still be able to move parts of the device for bone transport after having mounted the fixator.

According to Seybold et al. this intrinsic instability of the device itself is a disadvantage because it leads to a higher amount of shear forces at the site of the fracture or osteotomy and therefore could be a reason for failure of the procedure by development of pseudarthrosis or at least delayed union [11].

From a biomechanical point of view, this possible problem of intrinsic instability of hexapod devices is not solved. Regarding the reported information, we should work on minimalizing the intrinsic instability of Taylor Spatial Frames in order to reduce shear forces for further improving our clinical results and rates of bone healing.

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Probably, new biomechanical studies are necessary comparing different device modifications in order to reduce complications and the rates of delayed or non-union, especially in three-dimensional corrections of bony deformities using complex external fixators.

Lastly, we want to mention that during three-dimensional bone fragment transport calculated by computer software, bending of fixator device components should be minimalized because the software cannot compensate for this deviation. According to the beam theory of basic mechanics, orthogonally applied forces make components bend. One can reduce material bending by substituting tensioned wires with thicker struts. We find this helpful to produce more precise results after software dependent planning of bony deformity corrections.

Declaration of Competing Interest

None.

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