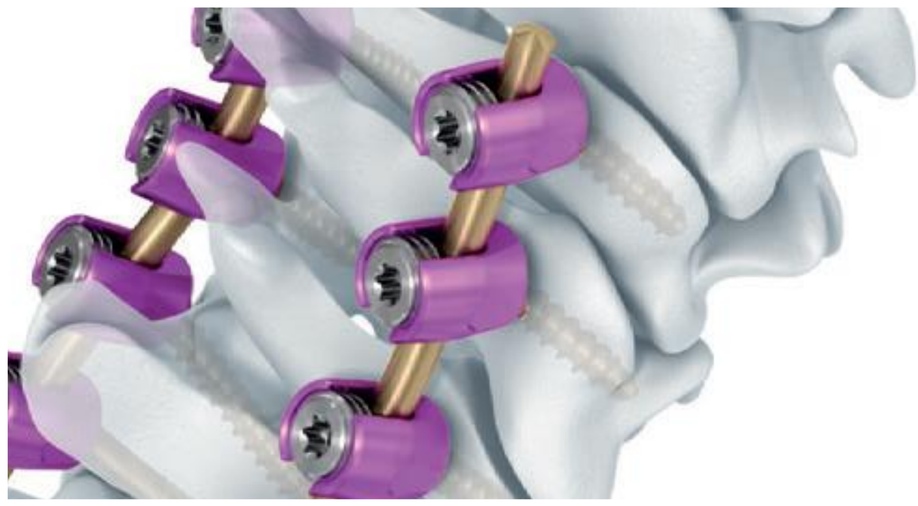
HSLU Hochschule Luzern

Technik & Architektur

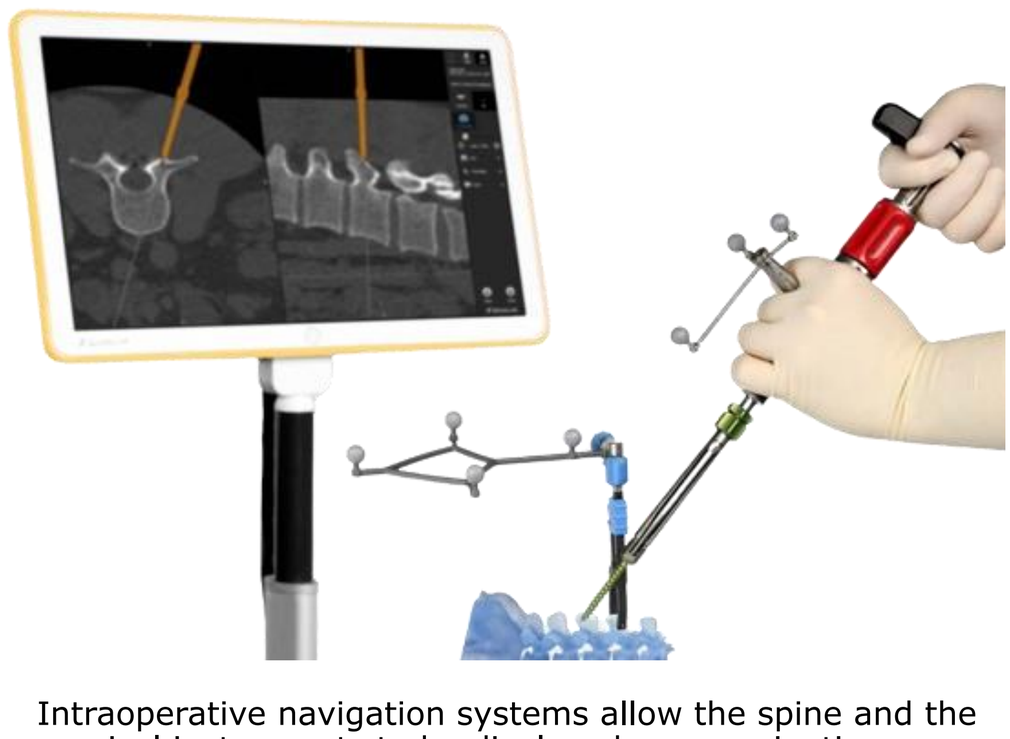
Bachelor's thesis Medical Engineering

Pedicle screw design optimisation for intraoperative navigation

Example of a pedicle screw from DePuy Synthes. (Source: DePuy Synthes)



Pedicle screws form an anchor to allow the stabilisation of the spine. (Source: DePuy Synthes)



Intraoperative navigation systems allow the spine and the surgical instruments to be displayed on a navigation screen. (Source: BrainLab)

Problem

Intraoperative navigation systems are used in spinal surgery to track the position of the spine and vertebrae as well as surgical instruments, relative to one another, in real time. The precision of an intra-operative navigation system is however greatly affected by the movement of the spine during the procedure. Any movement of the vertebrae results in a deviation between the actual spine position and its position displayed on the navigation screen.

It is in the nature of the spine that the vertebrae allow a certain degree of movement in relation to each other. The movement of the vertebrae can be caused by various surgical steps. Pre-drilling the holes, tapping and screwing in the pedicle screws generate axial forces as well as torques. These can lead to a displacement of the vertebrae which again has a negative impact on the accuracy of the navigation system and therefore the safety of the surgical procedure.

Solution

By optimising the pedicle screw design, the axial force and the torque when inserting the screws can be reduced. The focus is laid on the geometry of the screw tip. The screw design is determined by using data from studies that have already been carried out and ideas that have been gene-rated through an ideation process. The optimisations are implemented by modi-fying an existing screw with the new designs. The optimisations are intended to increase the safety of surgeries with intra-operative navigation systems.

Results

In principle, the screws could be improved to significantly reduce the axial force and slightly reduce the torque during insertion. The detailed results may not be described further due to confidentiality agreements.

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DePuy Synthes
THE ORTHOPAEDICS COMPANY OF Johnson & Johnson

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