Development of a Forceps Force Limiter Using Leaf Spring Buckling

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Abstract
To prevent accidents in minimally invasive surgeries, force limiters have been developed for forceps grippers. When a force limiter is in use, if the absolute value of its spring constant is reduced, the risk of damage to the organs decreases. This paper proposes the use of a leaf spring buckling mechanism as a force limiter for forceps. The results obtained indicate that the spring constant of a buckled leaf spring is lower than that of a normal coil spring. Furthermore, the use of a leaf spring allows the independent adjustment of its thickness and width, based on the stress and force values. This enables an easy calibration of the threshold value. In the experiments, the spring constant of the buckled leaf spring was 0.15 N/mm, which is half of that of a normal coil spring. After calibrating the gripping force, it was confirmed that the force limiter reduced the extent of damage to the dummy organs in the ex vivo experiments.

Full Text
Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF or as a LaTeX file in the Supplementary Files section.

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General force limiter mechanism.
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(A) Moment zero

(B) Slope zero

Figure 4

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Experimental setup for gripping force measurement.
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Proposed locking mechanisms.

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