Silk fibroin is a biomaterial that may be advantageous for use in surgical repair of tympanic membrane (TM) perforations. Silk fibroin, a protein polymer made by silkworms, is the strongest known natural fiber. It is elastic and degradable, does not cause tissue reactivity, and is noninfectious. In this study, we investigated the effects of repairing large TM perforations in rats with a thin silk patch compared with the commonly used paper patch.

Silk fibroin patches and paper patches were prepared for repair of TM perforations. We performed bilateral myringotomies 1.8 mm in diameter on 50 adult Sprague-Dawley rats with intact TMs. The perforations in the right ears of 40 rats were treated with a silk patch, and the perforations in the left ears of the same rats were treated with a paper patch. Ten rats acted as controls. Before and immediately after the perforation procedure, each TM was photographed daily through an endoscope until the perforations were closed, and again after 1 month. To examine the healing process at different points, two rats were killed 3, 5, 9, 11, and 14 days after myringotomy.

The mean healing times of the TM perforations on the silk-patch treated ears and the paper-patch treated ears were 7.2 ± 1.48 days and 9.1 ± 1.11 days, respectively (control, 10.38 ± 1.70 days). The difference between silk-patch and paper-patch treated ears was statistically significant (p < 0.001, paired t-test), with a mean difference of 1.9 days (95% confidence interval, 0.6 to 4.5 days). The mean perforation closure times were significantly shorter in silk-patch treated ears than in the control animals (p = 0.428, Kruskal-Wallis one-way analysis of variance). In the TM of rats treated with a silk patch, the healed membrane was two times thicker after treatment than before. This thickening was primarily due to hyperplasia of the connective tissue, which contains many fibroblasts oriented parallel to the surface of the TM.

The endoscopic and histological findings of this study provide evidence that silk-patch treatment accelerates wound healing and shortens TM perforation closure time. We suggest that the silk patch may prove to be an effective material for repairing TM perforations in human patients in an outpatient clinical setting.