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### 360 Spinal Cord Neural Interface

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**Introduction:** The spinal cord carries information from the brain to the periphery and vice versa. Interruption in these communication pathways, such as spinal cord injury, causes severe neurological disability and profoundly impacts patients and society. Bioelectronic interfaces have the potential to both record from and stimulate the spinal cord and eventually restore lost neurological functions. However, to date, spinal cord devices have only interfaced with the dorsal aspect of the spinal cord due to both anatomical and technological challenges. Here, we present a new thin-film, flexible electronics to circumferentially interface with the spinal cord, leading to a new paradigm of measuring and stimulating dorsal, lateral, and ventral tracts of the cord simultaneously using one device.

**Methods:** We designed a 32-channel staggered thin-film linear array and manufactured using photolithography techniques, both for rodent and human use. We conducted in silico and signal processing simulations. We implanted and validated the devices in adult Sprague-Dawley rats and carried out acute electrophysiology. We also implanted the devices in human cadavers where CSF was reconstituted.

**Results:** We measured multiple peripheral signals, their ability to be used to stimulate different motor tracts and show a proof-of-concept for using two circumferential devices to bridge a complete spinal cord injury using a rodent model, measuring, and stimulating in a closed-loop method. Finally, we demonstrate that a device of this type could be translated to human scale using a human cadaver model.

**Conclusion:** This device represents a step change in what is possible to achieve with bioelectronic interfaces in surgically challenging areas such as the spinal cord and, unlike previous attempts of probing the spinal cord circumferentially, sees a clear route to the clinic by using materials and surgical practices that reduce risk during implantation or removal.

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### Perceptions of Pain in Menopausal Women Undergoing Spinal Cord Stimulation

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**Introduction:** Older women transitioning to menopause undergo a myriad of physical symptoms such as low back pain, joint pain, mood disturbances, and chronic pain due to hormonal alterations<sup>1</sup>. Furthermore, aging results in altered perceptions of pain<sup>2</sup>. A current need exists to ascertain the benefits of spinal cord stimulation (SCS) in older women. We therefore retrospectively reviewed a prospectively collected database of thoracic SCS patients.

**Methods:** Thoracic SCS patients (n=128) were divided into premenopausal and menopausal (above age 51) cohorts, and then compared with male SCS patients. Outcomes were assessed at baseline and one year after the procedure. The scales used included the numeric rating scale (NRS), Oswestry Disability Index (ODI), Beck's Depression Inventory (BDI), McGill Pain Questionnaire (MPQ), and Pain Catastrophizing Scale (PCS). In addition, pain duration, anxiety, depression, and smoking were contrasted. These results were analyzed using unpaired t-tests, one-way analysis of variance (ANOVA), and chi-square tests. Mann-Whitney and Kruskal-Wallis test was used when the cohorts were not normally distributed.

**Results:** The cohorts included 23 females <51, 43 females 51 or older, and 62 males. The groups had similar outcomes in all metrics. As there was a paucity of women in the <51 group, similar analyses were considered separating female cohorts into those under and over 60 years old. In these analyses, females over 60 were notably different than men and women under 60 in that they had greater improvements in NRS (p = 0.026), ODI (p = 0.045), and BDI (p = 0.041).

**Conclusion:** Our findings suggest greater improvement in post-menopausal females when considering age 60 as a cohort. Whether the difference is actually seen earlier (i.e., at the average time of menopause onset) and this study was underpowered to detect it or whether there are other unappreciated differences between females between 51 and 60 needs to be better ascertained.

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