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New material Professor Jae Young Lee's joint research team develops an electrically conductive hydrogel nerve conduit that regenerates damaged nerves

- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Materials Science and Engineering Professor Jae Young Lee and Dankook University Professor Hee Seok Yang led a joint research team that developed a graphene-based conductive hydrogel nerve conduit, which is effective in regenerating damaged peripheral nerves.

* graphene: a two-dimensional material composed of a honeycomb of carbon atoms, which, in theory, has much higher strength than steel and has excellent thermal and electrical conductivity and is considered a dream material but has disadvantages such as high costs, wrinkles, and difficulty for mass production

- Peripheral nerve damage does not regenerate itself depending on the degree of damage, so surgical methods such as direct suture or autograft* are currently used. However, there are various problems such as nervous tissue tension and morbidity (probability of getting sick) depending on the pathological condition of the donor site.

* autograft: a surgical method in which nerves from other areas that are less utilized or unnecessary are separated and transplanted directly to the damaged area

- In addition, research is needed on the development of nerve conduits that can greatly promote nerve regeneration due to their low therapeutic capacity.

□ Biomaterials that conduct electricity are known to help regeneration of electrically active tissues such as damaged muscles, heart, and nerves, and in recent years, research on the development of conductive biomaterials for nerve regeneration has been actively conducted. Existing conductive materials, such as metals and films, have hard physical properties and are limited in use as biomaterials due to severe inflammatory reactions due to inconsistency of physical properties with tissues *in vivo*.

- Generally, reduced graphene has high electrical conductivity, but it is difficult to form a complex directly with the hydrogel because it is agglomerated without dispersing in aqueous states such as a biological environment.

□ Therefore, the research team developed and applied a method of manufacturing an electrically conductive hydrogel by producing a gelatin-based hydrogel containing graphene oxide, which has low conductivity but is evenly dispersed, and then made reduced graphene oxide* through a reduction process to improve conductivity.

* reduced graphene oxide: carbon material obtained by chemically reducing an oxidized form of graphene through a reducing agent

- To verify the efficacy *in vivo*, when a 10 mm distance damage was induced to the sciatic nerve of an experimental white mouse, a conductive hydrogel-based nerve conduit containing reduced graphene oxide was implanted between the damaged nerves. After 4 and 8 weeks, nerve regeneration was significantly promoted functionally and structurally. In particular, it was confirmed that the nerve regeneration ability was similar to that of autograft, which is currently used surgical procedure.

□ School of Materials Science and Engineering Professor Jae Young Lee said, "The multifunctional neural ductal system developed in this study is expected to become a tissue engineering platform that can be applied not only to damage of peripheral nerves, but also for the regeneration of various electrically active tissues such as the brain and muscles."

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