**Supplementary materials:**

**Supplementary figure 1. Infrared spectroscopy of the scaffold.** Peak values were found at 3010.13-2533.49 cm-1, 1838.73 cm-1, 799.30-1542.21cm-1.

**Supplementary figure 2. CD90+-CD105+ cells counting and comparisons between groups**

(A-B) Comparisons of CD90+-CD105+ cells in 3D-CH group and 3D-C group after 3 days (A) and 7 days (B) of co-culturing with the scaffolds. (C-D) Comparisons of CD90+-CD105+ cells after 3 days and 7 days of co-culturing with the scaffolds in 3D-C group (C) and 3D-CH group (D). ++*P* < 0.01.

**Supplementary figure 3. Comparisons of MEP in each group from the time of 3 months to 6 months after surgery.** (A-C) Comparisons of latency in TBI group (A), CH group (B), and 3D-CH group (C) from the time of 3 months to 6 months after surgery. (D-F) Comparisons of amplitude in TBI group (D), CH group (E), and 3D-CH group (F) from the time of 3 months to 6 months after surgery. \**P* < 0.05, \*\**P* < 0.01.

**Supplementary figure 4: sEMG and vGRF results of for all groups 3 months after implantation.** (A-D1) sEMG comparisons of bilateral hindlimbs in TBI group (A & A1), CH group (B & B1), 3D-CH group (C & C1), and Control group (D &D1). (E-H1) vGRF comparisons of bilateral hindlimbs in TBI group (E & E1), CH group (F & F1), 3D-CH group (G & G1), and Control group (H & H1). \**P* < 0.05, \*\**P* < 0.01.

**Supplementary figure 5. Assessment of joint motion status under the motion capture system.** (A-D) Comparisons of angle change in bilateral hindlimbs in the TBI group (A), CH group (B), 3D-CH group (C), and Control group (D). (E-H) Comparisons of joint trajectories in bilateral hindlimbs in the TBI group (E), CH group (F), 3D-CH group (G), and Control group (H). LHL: left hindlimb, RHL: right hindlimb.

**Supplementary table 1.** **Detailed data of porosity ratio in groups.**