Title: Basic research and clinical translation of structural and functional reconstruction of the knee meniscus

Name: Jia-Kuo Yu

Orthopaedic and Sports Medicine Centerl, Beijing Tsinghua Changgung Hospital, Tsinghua University, China; Institute of Orthopedic and Sports Medicine of Tsinghua Medicine, Tsinghua University,China.

Structural and functional reconstruction after meniscal injury is difficult and patient volume is high. The annual operation volume of meniscus in the United States is more than 2 million cases, and it is increasing year by year. China is 4.3 times more than the United States. In the clinical research of meniscus, Yu's team pioneered the first anatomical minimally invasive human allograft meniscus transplantation: preserving the tibial ligaments of the transplanted meniscus, fixing the bone plugs in the anterior and posterior horn of the posterior horn of the lateral meniscus and braiding the anterior and posterior horn of the medial meniscus through precise size matching and anterior and posterior horn localization, combining with the minimally invasive suture of the FasT-Fix, to restore the anatomical peripheral structure of the meniscus. Follow-up of 21 patients for more than 10 years showed a 94% survival rate of the transplanted meniscus. Follow-up results at 5 and 11 years showed better cartilage protection with meniscus transplantation than meniscectomy, and superior cartilage protection than meniscectomy even when graft meniscus protrusion occurred. In a comparison of immediate and delayed meniscal transplantation, follow-up results showed better cartilage protection with immediate transplantation and healthier signals of transplanted meniscus. In a basic study of meniscus, meniscal regeneration and chondroprotective effects were observed in a rabbit model of meniscectomy after trimming the meniscus from pigs and transplanting it. Moreover, no antibody was detected in the synovial fluid of the rabbit knee joint, and its serum antibody disappeared after 2 weeks. In the large-animal study of partial meniscus transplantation and whole meniscus transplantation, the former possessed better efficacy when evaluated by combining the chondroprotective effect, meniscus regeneration effect, and inflammatory factors in the joint cavity. It is worth mentioning that Yu's basic research and clinical research are not completely independent, and the team realized the clinical translational application of basic research through the preparation of factory-made tissue-engineered meniscus. The first generation of tissue-engineered meniscus was a 3D printed scaffold of PCL material combined with BMSCs, which achieved good efficacy in a rabbit meniscus defect model. On this basis, the second generation of bionic tissue-engineered meniscus was constructed, and the third generation of three-dimensional spatial bionic, and anti-inflammatory and anti-oxidant meniscus, and the relevant results have been transformed into 30 million RMB. In the future, it is expected that the basic research will be applied to the clinic, and promote the optimization of clinical meniscus treatment plan.

Biography: (Up to 150 words)

Mr. Yu is a Distinguished Professor of Tsinghua University School of Medicine, leading 42 research projects, including 14 national projects. Prof. Yu has published more than 100 SCI papers as the first author and corresponding author, with 15 papers with IF>10 (the highest IF=32), including Science journals, Adv Mater, Bioact Mater, and Adv Sci. He has edited and co-edited 10 monographs. He has received several scientific and technological awards as the first complete author, and has been granted 69 patents and 2 software copyrights. The total amount of patents transformed is more than 100 million RMB. Translated results have been industrialized and promoted for clinical application.

Presenting author details

Full name : Jia-Kuo Yu
Mobile Number / Whatsap Number: 13331031844
Twitter account : -
Linked In account : -
Session name/ number :010-56119502
Category: Oral presentation
Date of Birth : 1963/08/08/

Images (if any)

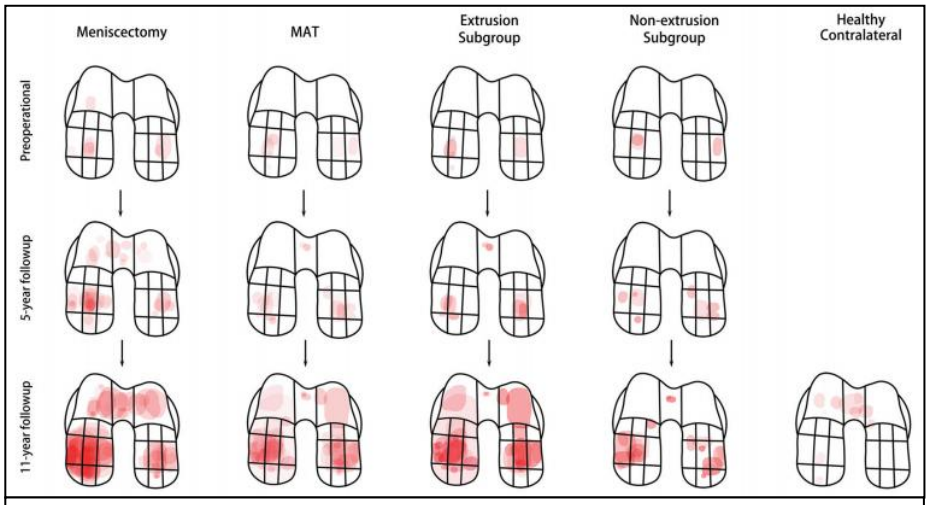


Fig 1. Meniscus transplantation provides better cartilage protection than meniscectomy, and even when graft meniscus protrusion occurs, the protection of cartilage is still superior to that of meniscectomy.

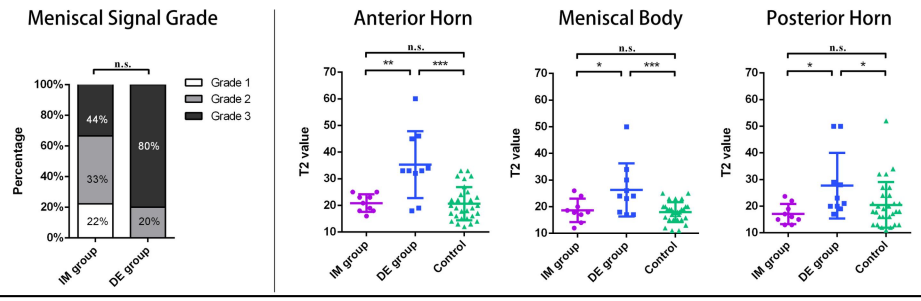


Fig 2. In meniscus immediate grafting versus delayed grafting, immediate grafting had better cartilage protection and healthier grafted meniscus signals.

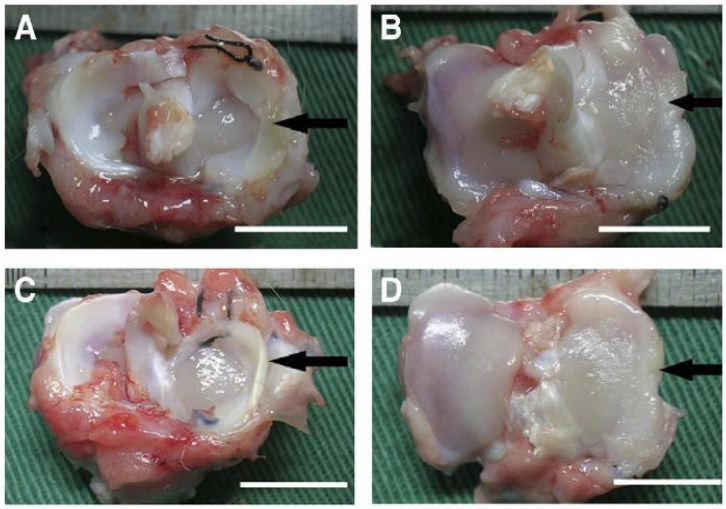
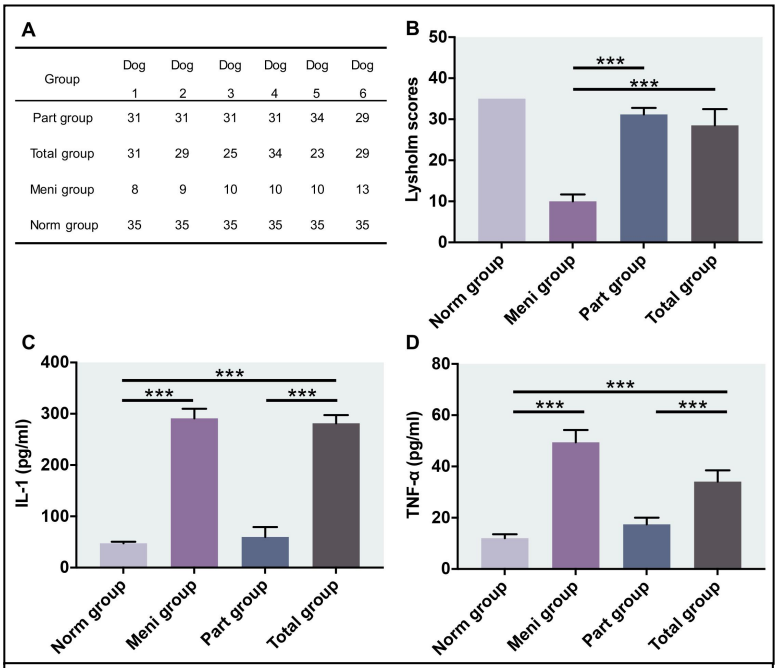


Fig 3. Animal experiments show no gross and histologic differences between xenografts and homografts.



Group	Dog 1	Dog 2	Dog 3	Dog 4	Dog 5	Dog 6
Part group	31	31	31	31	34	29
Total group	31	29	25	34	23	29
Meni group	8	9	10	10	10	13
Norm group	35	35	35	35	35	35

Fig 4. Partial meniscus grafts are more efficacious than whole grafts.

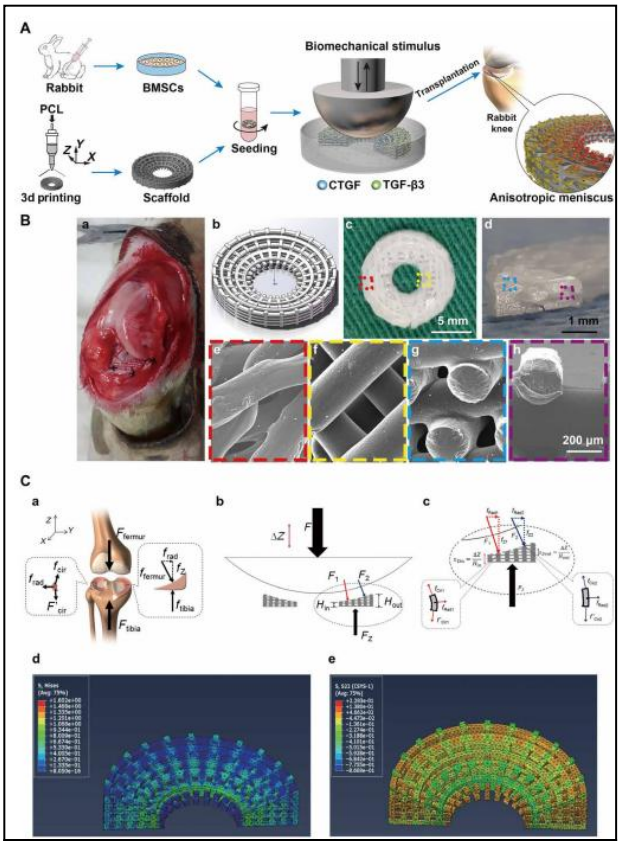


Fig 5. Bionic Tissue Engineering Meniscus Construction Program.

5 Recent Publications (if any)

1. Deng R, Zhao R, Zhang Z, Chen Y, Yang M, Lin Y, Ye J, Li N, Qin H, Yan X, Shi J, Yuan F, Song S, Xu Z, Song Y, Fu J, Xu B, Nie G, Yu JK. Chondrocyte membrane-coated nanoparticles promote drug retention and halt cartilage damage in rat and canine osteoarthritis. Sci Transl Med. 2024;16:eadh9751.
2. Xu B, Ye J, Fan BS, Wang X, Zhang JY, Song S, Song Y, Jiang WB, Wang X, Yu JK. Protein-spatiotemporal partition releasing gradient porous scaffolds and anti-inflammatory and antioxidant regulation remodel tissue engineered anisotropic meniscus. Bioact Mater. 2023;20:194-207.
3. Yang M, Zhang ZC, Yuan FZ, Deng RH, Yan X, Mao FB, Chen YR, Lu H, Yu JK. An immunomodulatory polypeptide hydrogel for osteochondral defect repair. Bioact Mater. 2023;19:678-689.
4. Ye J, Deng R, Wang X, Song S, Xu X, Zhang JY, Xu BB, Wang X, Yu JK. Intra-articular Histone Deacetylase Inhibitor Microcarrier Delivery to Reduce Osteoarthritis. Nano Lett. 2023;23:10832-10840.
5. Fan BS, Ye J, Xu BB, Sun ZW, Zhang JY, Song ST, Wang XJ, Song YF, Zhang ZZ, Jiang D, Yu JK. Study on feasibility of the partial meniscal allograft transplantation. Clin Transl Med. 2022;12:e701.