

12 STEM CELLS AND REGENERATION

Innovative Orthopaedic Biomaterial and Drug Translational Research

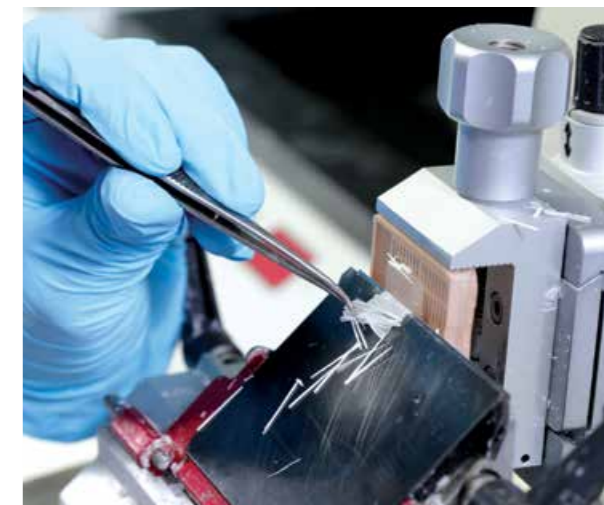


Principal Investigator
Professor Ling Qin



Team

Ziyi Chen | Dick Chow | Can Cui | Bingyang Dai | Xuan He | Le Huang | Xu Li |
Ye Li | Jie Mi | Qianqian Pang | Wenxue Tong | Jiali Wang | Jiankun Xu | Hao Yao |
Ri Zhang | Nianye Zheng | Lizhen Zheng | Liangbin Zhou | Li Zou | Hai Yue Zu



■ Research Progress Summary

Professor Ling Qin and team focus on the research and development of innovative orthopaedic implants and drugs or supplements for prevention and treatment of skeletal disorders and injuries with limited healing potential, including patients with impaired healing capacity, large bone defects, and healing at different tissue types such as the bone-tendon/bone-cartilage interface. He has been developing innovative biomedical and tissue engineering products, clinical indication-orientated treatment regimens and protocols that utilise stem cells, bioactive and biodegradable materials (e.g. biodegradable Magnesium (Mg)), endogenous and exogenous growth factors, and external biophysical stimuli to enhance musculoskeletal tissue regeneration. The goal of his research is to facilitate not only anatomical but more importantly also functional restoration to achieve early rehabilitation and reduce disease associated morbidity and mortality.



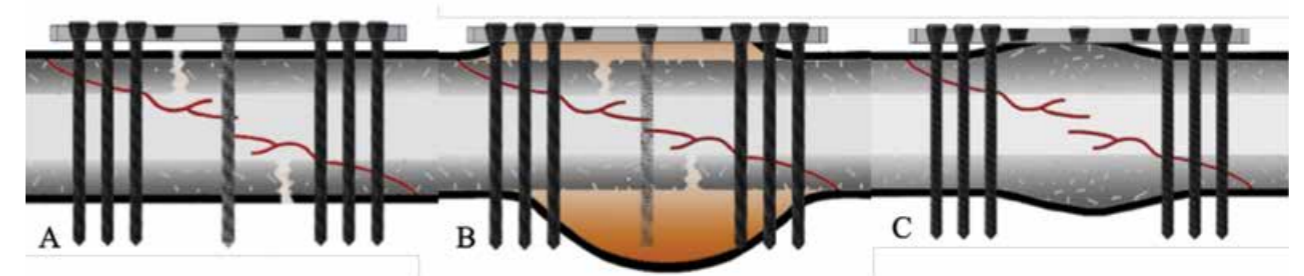


Being multidisciplinary in nature, Professor Qin and his team have been collaborating with local and international engineers and material scientists for developing innovative biomaterials and drugs, such as to redesign the current commercially available implant to incorporate with Mg-based components. Recently, they have tested different Mg-based alloys and have applied different coating to prevent the rapid degradation. One innovative approach is that the team has modified current commercially available implants to incorporate Mg-based components to enhance bone healing. This hybrid

implant, with both conventional titanium metal and Mg components, can deliver Mg to fracture sites also have great potential in facilitating and enhancing fracture healing, which could accelerate an early initiation of mobility and rehabilitation of patients with fractures. They have been working on Collaborative Research Fund and Theme-based Research Scheme which are funded previously and meanwhile also secured one General Research Fund and one Innovation and Technology Fund Tier 2 that enhances the team's collaborations with industrial sectors.

Design of innovative interlocking Ti-Mg hybrid locking screw by Professor Qin's team. This locking screw consists of a Mg-based screw body and a titanium screw head. The screw will be used to stabilize fractured bone with locking plate. The Mg-based screw body will degrade over time and the released Mg ions will stimulate the healing of the fracture.

Source: Mr. Wing Ho Chau



An improved fracture healing mechanism in this application is shown by using our Ti-Mg hybrid locking screw and plate system (A, B and C). A: Fracture is fixed with locking plate and screws. B: the healing process of the fracture fixed with locking plate and screws. This design will leave some space between the plate and bone surface, which will induce callus formation and enhance fracture healing. C: The impaired healing part is avoided and the overall healing quality is enhanced compared to fixation with compression plate.

Source: Mr. Wing Ho Chau

Research and Scholarship

Research Awards and Recognitions

Member's Full Name	Details
Ling Qin, Dick Chow, Jiali Wang, Jiankun Xu	Gold Medal with Congratulations of Jury, The 46 th Edition of the International Exhibition of Inventions of Geneva (11-15 April, 2018)
Jiankun Xu	Savio L-Y. Woo Young Researcher Award, International Symposium on Ligament & Tendon – XVII (21 April, 2018)
Wenxue Tong	Third Young Investigator Prize, the 12 th International Congress on Orthopaedic Advanced Techniques and Clinical Translational Research & the 1 st Young Investigator Forum of International Chinese Musculoskeletal Research Society (4-6 May, 2018)
Jiankun Xu	Second Young Investigator Prize, the 12 th International Congress on Orthopaedic Advanced Techniques and Clinical Translational Research & the 1 st Young Investigator Forum of International Chinese Musculoskeletal Research Society (4-6 May, 2018)
Wenxue Tong	Best Poster of the International Combined Orthopaedic Research Societies, ORS 2018 Annual Meeting (March 9-13, 2018)
Dick Chow	Shihao Liu-Xianyi Zhu Memorial Best Paper Awardee, 9 th International Conference on Osteoporosis and Bone Research, (17-20 Oct, 2018)
Xiaodan Chen	Shihao Liu-Xianyi Zhu Memorial Best Paper Awardee, 9 th International Conference on Osteoporosis and Bone Research, (17-20 Oct, 2018)
Ye Li	Shihao Liu-Xianyi Zhu Memorial Best Paper Awardee, 9 th International Conference on Osteoporosis and Bone Research, (17-20 Oct, 2018)
Jiankun Xu	Webster Jee Travel Award, 9 th International Conference on Osteoporosis and Bone Research, (17-20 Oct, 2018)
Jiankun Xu	Best Oral Presentation Award, 4 th Asia-Pacific Bone & Mineral Research Meeting and Osteoporotic Fracture Prevention & Treatment Conference 2018 (11-13 May, 2018)
Jiankun Xu	PGS Research Output Award 2017, CUHK
Ling Qin, Jiali Wang, Jiankun Xu	2018年中華醫學科技獎獲獎二等獎（第3完成人）「股骨頭壞死的基礎、臨床研究及轉化應用」

Academic Editorships and Reviews

Member's Full Name	Details
Ling Qin	Editor-in-Chief, Journal of Orthopaedic Translation
Ling Qin	Editorial Advisory Board Member, Recent Patents on Biomedical Engineering
Ling Qin	Member, International Society of Musculoskeletal and Neuronal Interactions
Ling Qin	Member, World Journal of Rheumatology
Ling Qin	《中華創傷骨科雜誌》第三屆編委
Ling Qin	Associate Editor, Orthopaedic Surgery (English version of Chin J Orthop Surg)
Ling Qin	Member, Journal Recent Patents on Mechanical Engineering.
Ling Qin	International Review Panel, European Cells & Materials Journal European Cells & Materials Journal
Ling Qin	Editor Board Member, Current Osteoporosis Report

Journal / Conference Reviews

Member's Full Name	Details
Ling Qin	Reviewer, 4 th Asia-Pacific Bone & Mineral Research Meeting and Osteoporotic Fracture Prevention & Treatment Conference 2018 (11-13 May, 2018)

Grants and Consultancy

Name	Project Title	Funding Source	Start Date	End Date	Amount (HK\$)
Ling Qin	Functional Bone Regeneration in Challenging Bone Disorders and Defects	Research Grant Council – Theme-based Research Scheme	01/11/2017	31/10/2022	33,333,000
Ling Qin	Joint R&D of Magnesium-based Orthopaedic Implants	Research Grant Council – Collaborative Research Fund	01/03/2018	28/02/2021	5,545,807
Ling Qin	An Innovative Bio-intramedullary Nail with Osteogenic Mg-ions for Accelerating Bone Defect Repair: A Proof-of-Concept Study	Research Grant Council – General Research Fund	01/01/2018	31/12/2020	929,880

■ Publications

A. Journal Papers

1. Tian L, Tang N, Ngai T, Wu C, Ruan Y, Huang L, Qin L. Hybrid fracture fixation systems developed for orthopaedic applications: A general review. *Journal of Orthopaedic Translation*. 2019;16:1-13. doi:10.1016/j.jot.2018.06.006. (Review)
2. Chow DH, Zheng L, Tian L, Ho K-S, Qin L, Guo X. Application of ultrasound accelerates the decalcification process of bone matrix without affecting histological and immunohistochemical analysis. *Journal of Orthopaedic Translation*. September 2018. doi:10.1016/j.jot.2018.08.001.
3. Lai Y, Cao H, Wang X, Chen S, Zhang M, Wang N, Yao Z, Dai Y, Xie X, Zhang P, Yao X, Qin L. Porous composite scaffold incorporating osteogenic phytomolecule icariin for promoting skeletal regeneration in challenging osteonecrotic bone in rabbits. *Biomaterials*. 2018;153:1-13. doi:10.1016/j.biomaterials.2017.10.025.
4. Chen S, Zheng L, Zhang J, Wu H, Wang N, Tong W, Xu J, Huang L, Zhang Y, Yang Z, Lin G, Wang X, Qin L. A novel bone targeting delivery system carrying phytomolecule icaritin for prevention of steroid-associated osteonecrosis in rats. *Bone*. 2018;106:52-60. doi:10.1016/j.bone.2017.09.011.
5. Wang J, Wu Y, Li H, Liu Y, Bai X, Chau W, Zheng Y, Qin L. Magnesium alloy based interference screw developed for ACL reconstruction attenuates peri-tunnel bone loss in rabbits. *Biomaterials*. 2018;157:86-97. doi:10.1016/j.biomaterials.2017.12.007.
6. Sheng Y, Tian L, Wu C, Qin L, Ngai T. Biodegradable Poly(l-lactic acid) (PLLA) Coatings fabricated from nonsolvent induced phase separation for improving corrosion resistance of magnesium rods in biological fluids. *Langmuir*. 2018;34(36):10684-10693. doi:10.1021/acs.langmuir.8b02322.
7. Tian L, Sheng Y, Huang L, Chow DHK, Chau WH, Tang N, Ngai T, Wu C, Lu J, Qin L. An innovative Mg/Ti hybrid fixation system developed for fracture fixation and healing enhancement at load-bearing skeletal site. *Biomaterials*. 2018;180:173-183. doi:10.1016/j.biomaterials.2018.07.018.
8. Zhu TY, Yip BH, Hung VW, Choy CW, Cheng KL, Kwok TC, Cheng JC, Qin L. Normative standards for HRpQCT parameters in Chinese men and women. *Journal of Bone and Mineral Research*. 2018;33(10):1889-1899. doi:10.1002/jbmr.3481.
9. Zheng N, Liu X, Zhang R, Ho I, Chen S, Xu J, Yao H, Wang J, Yue J, Wang X, Qin L. Jingshu Keli attenuates cervical spinal nerve ligation-induced allodynia in rats through inhibition of spinal microglia and Stat3 activation. *Spine Journal*. 2018;18(11):2112-2118. doi:10.1016/j.spinee.2018.06.354.
10. Hu Y, Zhang T, Huang H, Cheng W, Lai Y, Bai X, Chen J, Yue Y, Zheng Z, Guo C, Qin L, Zhang P. Fracture healing in a collagen-induced arthritis rat model: Radiology and histology evidence. *Journal of Orthopaedic Research*. 2018;36(11):2876-2885. doi:10.1002/jor.24060.
11. Huang L, Wang X, Cao H, Li L, Chow DHK, Tian L, Wu H, Zhang J, Wang N, Zheng L, Yao X, Yang Z, Qin L. A bone-targeting delivery system carrying osteogenic phytomolecule icaritin prevents osteoporosis in mice. *Biomaterials*. 2018;182:58-71. doi:10.1016/j.biomaterials.2018.07.046.
12. Yan X, Wan P, Tan L, Zhao M, Qin L, Yang K. Corrosion and biological performance of biodegradable magnesium alloys mediated by low copper addition and processing. *Materials Science and Engineering C*. 2018;93:565-581. doi:10.1016/j.msec.2018.08.013.
13. Li ZR, Cheng LM, Wang KZ, Yang NP, Yang SH, He W, Wang YS, Wang ZM, Yang P, Liu XZ, Luo YZ, Sun W, Wang HT, Zheng LZ, Wang XL, Qin L. Herbal Fufang Xian Ling Gu Bao prevents corticosteroid-induced osteonecrosis of the femoral head—A first multicentre, randomised, double-blind, placebo-controlled clinical trial. *Journal of Orthopaedic Translation*. 2018;12:36-44. doi:10.1016/j.jot.2017.11.001.
14. Zheng LZ, Wang JL, Kong L, Huang L, Tian L, Pang QQ, Wang XL, Qin L. Steroid-associated osteonecrosis animal model in rats. *Journal of Orthopaedic Translation*. 2018;13:13-24. doi:10.1016/j.jot.2018.01.003 (Review)
15. Li L, Long J, Li L, Cao H, Tang T, Xi X, Qin L, Lai Y, Wang X. Quantitative determination of residual 1,4-dioxane in three-dimensional printed bone scaffold. *Journal of Orthopaedic Translation*. 2018;13:58-67. doi:10.1016/j.jot.2017.06.004.
16. Yu W, Li R, Long J, Chen P, Hou A, Li L, Sun X, Zheng G, Meng H, Wang Y, Wang A, Sui X, Guo Q, Tao S, Peng J, Qin L, Lu S, Lai Y. Use of a three-dimensional printed polylactide-coglycolide/tricalcium phosphate composite scaffold incorporating magnesium powder to enhance bone defect repair in rabbits. *Journal of Orthopaedic Translation*. 2019;16:62-70. doi:10.1016/j.jot.2018.07.007. (Epub ahead of print)
17. Yan X, Wan P, Tan L, Zhao M, Qin L, Yang K. Corrosion and biological performance of biodegradable magnesium alloys mediated by low copper addition and processing. *Materials Science and Engineering C*. 2018;93:565-581. doi:10.1016/j.msec.2018.08.013.

B. Patent and Trademark Registrations

1. Hybrid Implant System and Manufacturing Method, US Patent (Application no. 15/874,532)
2. Registration of Trade Mark: Mgmax (健镁牌)