RGC Ref.: N_CUHK449/13 NSFC Ref.: 51361165101
(please insert ref. above)

The Research Grants Council of Hong Kong
NSFC/RGC Joint Research Scheme
Joint Completion Report

(Please attach a copy of the completion report submitted to the NSFC by the Mainland researcher)

Part A: The Project and Investigator(s)

1. Project Title

Design and Biological Response of Biodegradable Mg-Sr-Zn Alloy for Ligament/tendon-bone Reconstruction

2. Investigator(s) and Academic Department/Units Involved

	Hong Kong Team	Mainland Team
Name of Principal Investigator *(with title)*	Dr. QIN Ling	Dr. ZHENG Yufeng
Post	Professor and director	Professor and vice director
Unit / Department / Institution	Musculoskeletal Research Laboratory, Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong	Department of Materials Science and Engineering, College of Engineering, Peking University
Contact Information	qin@ort.cuhk.edu.hk	yfzheng@pku.edu.cn
Co-investigator(s) *(with title and institution)*	Prof. LI Gang, Dr. XIE Xinhui, Dr. ZHANG Yifeng, Dr. WANG Jiali	Dr. CHENG Yan, Ms. FANG Yanhua, Dr. LI Nan, Ms. ZHOU Weirui, Dr. LI Huafang, Dr. WU Yuanhao

3. Project Duration

	Original	Revised	Date of RGC/ Institution Approval *(must be quoted*)
Project Start date	1 January 2014	NA	
Project Completion date	31 December 2017	NA	
Duration *(in month)*	48	NA	
Deadline for Submission of Completion Report	31 Dec, 2018	NA	

Part B: The Completion Report

5. Project Objectives

5.1 Objectives as per original application

1. *To prepare and design Mg-Sr-Zn interference screws for experimental study using an established rabbit ACL reconstruction model and test its anabolic effects on osteogenesis using rabbit bone MSCs (bone marrow stem cells) and regeneration of interface fibrocondrogenesis relevant to TBI reconstruction and regeneration of interface fibrocartilage zone using TDSC (tendon/ligament-derived stem cells) in vitro;*

2. *To evaluate the degradable and the mechanical properties of Mg-Sr-Zn interference screw and its biocompatibility and safety in vitro and in vivo using the established ACL reconstruction model;*

3. *To evaluate the treatment efficacy, i.e. enhancement of TBI interface healing and its underlying mechanisms related to osteogenesis and fibrocondrogenesis of the degraded elements from Mg-Sr-Zn interference screw on the host tissue using the same ACL reconstruction model in rabbit.*

5.2 Revised Objectives

Date of approval from the RGC: NA

Reasons for the change: NA

6. Research Outcome

Major findings and research outcome
(maximum 1 page; please make reference to Part C where necessary)

1. Mg-6Zn-0.5Sr showed best mechanical strength and corrosion resistance without cell toxicity concerns;

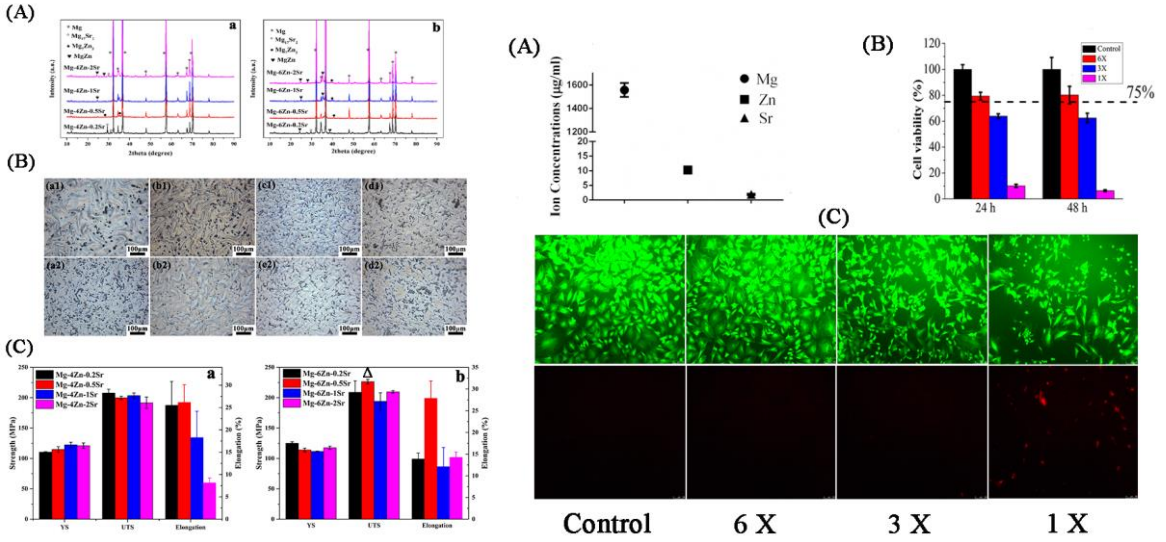

Figure 1. Mg-6Zn-0.5Sr showed balanced mechanical strength and corrosion resistance without inducing cell toxicity.

2. Mg-6Zn-0.5Sr interference screws showed much higher maximal torque than high-purity Mg interference screws;

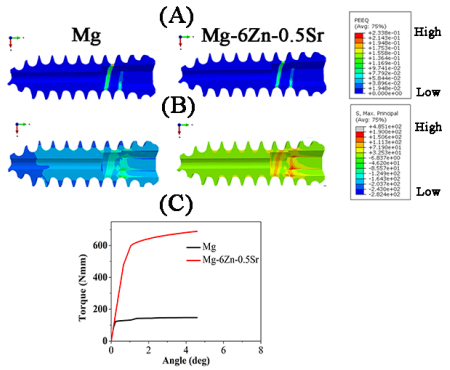

Figure 2. Mg-6Zn-0.5Sr screw had much higher maximal torque than high-purity Mg screw

3. Compared to the PLGA interference screw, Mg-6Zn-0.5Sr interference screw significantly promoted the tendon-bone healing and reduced the peri-tunnel bone loss.

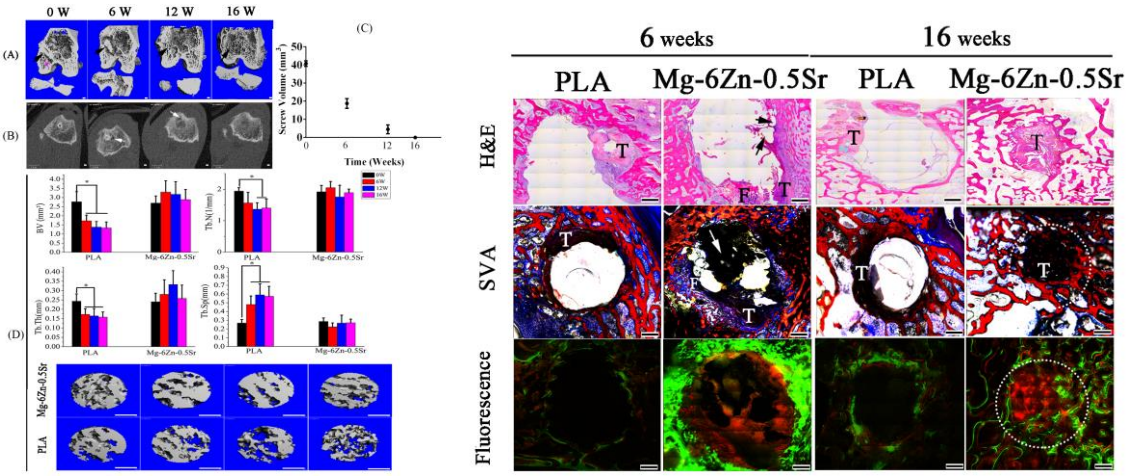

Figure 3. Compared to PLA screw, Mg-6Zn-0.5Sr interference screw attenuated the peri-tunnel bone loss and promoted the bony ingrowth into the tendon-bone interface

Potential for further development of the research and the proposed course of action *(maximum half a page)*

1. To increase the corrosion resistance of Mg-6Zn-0.5Sr through MAO coating.
2. To test large animal model by using modified Mg-6Zn-0.5Sr interference screw.
3. To try clinical translational work for the use of modified Mg-6Zn-0.5Sr interference screw.

7. The Layman's Summary

(describe in layman's language the nature, significance and value of the research project, in no more than 200 words)

Biodegradable Mg-6Zn-0.5Sr is strong enough as potential interference screws and can promote your healing quality after ACL reconstruction.

Part C: Research Output

8. Peer-reviewed journal publication(s) arising directly from this research project

(Please attach a copy of each publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.)

The Latest Status of Publications				Author(s) ***(bold** the authors belonging to the project teams and denote the corresponding author with an asterisk*)*	Title and Journal/ Book *(with the volume, pages and other necessary publishing details specified)*	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this report *(Yes or No)*	Acknowledged the support of this Joint Research Scheme *(Yes or No)*	Accessible from the institutional repository *(Yes or No)*
Year of publication	Year of Acceptance *(For paper accepted but not yet published)*	Under Review	Under Preparation *(optional)*						
2014				**LI Huafang, ZHENG Yufeng*, QIN Ling**	Progress of biodegradable metals, Progress in Natural Science:Materials International 2014; 244: 414–422. (SCI IF=1.873)	2015-12-31	Yes (**Appendix 1**)	Yes	Yes

2015				**LI Huafang, XIE Xinhui, ZHENG Yufeng*,** CONG Ying, ZHOU Feiyu, QIU Kejin, WANG Xiang,CHEN Shihui, HUANG Le, TIAN LI, **QIN Ling***	Development of biodegradable Zn-1X binary alloys with nutrient alloying elements Mg, Ca and Sr, Scientific Reports 2015; 5: 10719. (SCI IF=5.578)	2015-12-31	Yes (**Appendix 2**)	Yes	Yes
2015				**WANG Jiali,** WITTE Frank, XI Tingfei, **ZHENG Yufeng,** YANG Ke, YANG Yuansheng, ZHAO Dewei, MENG Jian, LI Yangde, LI Weirong, CHAN Kaiming, **QIN Ling***	Recommendation for modifying current cytotoxicity testing standards for biodegradable magnesium-based materials, Acta Biomaterialia 2015; 21: 237–249. (SCI IF=6.383)	2015-12-31	Yes (**Appendix 3**)	Yes	Yes
2017				**J.L. Wang**, J.K. Xu, B. Song, D.H. Chow, P.S.H. Yung**, L. Qin**,	Magnesium (Mg) based interference screws developed for promoting tendon graft incorporation in bone tunnel in rabbits, Acta Biomater 63 (2017) 393-410. (SCI IF=6.383)	2018-12-14	Yes (**Appendix 4**)	Yes	Yes
2018				**J.L. Wang, Y.H. Wu, H.F. Li**, Y. Liu, X.L. Bai, W.H. Chau, **Y.F. Zheng, L. Qin**	Magnesium alloy based interference screw developed for ACL reconstruction attenuates peri-tunnel bone loss in rabbits. Biomaterials 157 (2018) 86-97. (SCI IF=8.806)	2018-12-14	Yes (**Appendix 5**)	Yes	Yes

9. Recognized international conference(s) in which paper(s) related to this research project was/were delivered *(Please attach a copy of each delivered paper. All listed papers must acknowledge RGC's funding support by quoting the specific grant reference.)*

Month/Year/ Place	Title	Conference Name	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this report *(Yes or No)*	Acknowledged the support of this Joint Research Scheme *(Yes or No)*	Accessible from the institutional repository *(Yes or No)*
11/2015/Haikou (Accepted for oral presentation)	Design and Development of novel biodegradable Zn-based alloys	2015 Chinese Biomaterials Congress		Yes (**Appendix 6**)	Yes	No

10. Student(s) trained *(Please attach a copy of the title page of the thesis.)*

Name	Degree registered for	Date of registration	Date of thesis submission/ graduation
Jiali Wang	PhD (**Appendix 7)**	September, 2012	March, 2016

11. Other impact *(e.g. award of patents or prizes, collaboration with other research institutions, technology transfer, etc.)*

Awards: LI Huafang won the "Young Scientist Award" for the oral presentation of "Design and Development of novel biodegradable Zn-based alloys" in the 2015 Chinese Biomaterials Congress held in Haikou Nov. 2015 (**Appendix 8**).

Collaborations: The PI's team has been collaborating with our mainland partner Prof. Zheng YF's team and also extended to international collaborations with a world leading expert Prof. Frank Witte from Germany in this R&D program. More academic and translational work will be performed in the future studies.