AAO Foundation Final Report

Type of Award: Orthodontic Faculty Development Fellowship Award (OFDFA)

Name of Principal Investigator: Jin Hee Kwak, D.D.S., M.S.

Title of Project: Patient-oriented Craniofacial Research

Period of AAOF Support: 7-1-16 to 6-30-17

Amount of Funding: $20,000

Summary/Abstract (250 words):

The goal of this proposal is to provide the Proposed Fellow, Jin Hee Kwak, DDS, MS, with the opportunity to continue developing her academic career as a full-time faculty member in Section of Orthodontics at the UCLA School of Dentistry. Dr. Kwak currently serves as the Clinic Director of the Postgraduate Orthodontics Program at UCLA, and holds a K08 Mentored Clinical Scientist Research Career Development Award from NIDCR (awarded in this funding period). She plans to establish herself as a scientist in clinical orthodontics and translational research, as a mentor to dental students and orthodontic residents, and as a practicing orthodontist. The Orthodontic Faculty Development Fellowship Award from the American Association of Orthodontists Foundation will greatly support her development in education and research. Dr. Kwak's primary mentor will be Dr. Kang Ting, a well-established molecular bone biologist and the Chair of the Division of Growth and Development and the Section of Orthodontics at UCLA. In addition, she will be co-mentored by Dr. Won Moon, the Program Director of the Postgraduate Orthodontics Program, Dr. Benjamin Wu, the Chair of the Division of Advanced Prosthodontics at the UCLA School of Dentistry and the UCLA Department of Bioengineering, and Dr. Chia Soo, the Vice Chair of Research at the UCLA School of Medicine. Dr. Kwak will follow a well-structured plan of education, research, teaching, and clinical practice to enhance the abilities she will need to pursue her academic career in orthodontics.

Research Project Description:

The award proposal outlines her development plans in education, research, teaching, and clinical aspects. The specific aims of Dr. Kwak's research component for the funding period are as follows:

(1) Investigate the effects and stability of mini-implant assisted rapid palatal expander (MARPE) based treatment and craniofacial deformity patient treatment.
(2) Optimize the dosage and formulation of NELL-1 as a systemic therapy in mice.
(3) Investigate the effects of an optimized systemic NELL-1 therapy in mice in space (study in collaboration with NASA-CASIS).

Response to the following questions:

1. **Were the original, specific aims of the proposal realized?**

(i) Educational component: As proposed, leadership meetings were attended as below:

• The 2017 Society of Educators (SOE) as part of the American Association of Orthodontists Annual Session in San Diego, CA, April 2017.
• Formed an advisory committee of renowned clinician scientists at UCLA and submitted a successful K08 proposal to NIDCR. Active meetings and formulation of a comprehensive career development plan were done.

(ii) Research component: Significant progress has been made for the three proposed research projects, resulting in ***three*** publications and ***four*** abstract presentations with one highlighted in ***Upward*** (Issue 3), the quarterly magazine of the International Space Station (ISS) National Lab (can be viewed at *http://www.iss-casis.org/NewsEvents/NewsDetail/tabid/122/ArticleID/231/ArtMID/581/Upward-Issue-3-–-the-quarterly-magazine-of-the-ISS-National-Lab.aspx*). In addition, we have finalized initiated the Flight Operation of the NASA project after two years of Ground Operation in preparation for the spaceflight. We launched the Space-X CRS-11 rocket that carried our rodents up to the ISS on June 3, 2017. The live-return of half of these rodents is expected to occur on the week of July 4, 2017, and they will continue the NELL-1 therapy at UCLA for another month. The same will be done with half of the Ground controls currently housed and treated at the Kennedy Space Center, FL. All of the full-flight, live-return and ground control animals will be harvested at the same time and analyzed identically.

(iii) Teaching component: As proposed, I chaired and taught the following postgraduate orthodontic academic courses:

Clinical courses:
• Introduction to Orthodontics (DS492)
• Orthodontic Retainer Course (DS308.08)
• Typodont Course (DS307.11)
• Post-doctoral Orthodontic Clinic (DS308/07.03)- weekly clinic supervision.

Didactic course:
• Craniofacial growth and development- Biological Basis (DS300.03)

(iv) Clinical component: As proposed, I taught and prepared residents to complete the ABO certification process at the end of their residency program. All ***eight*** residents graduating this year are expected to present all six cases to ABO within the next year. I also taught and supervised patient care in the post-doctoral orthodontic clinic throughout the year. I also continued to practice orthodontics at the UCLA Faculty Group Dental Practice once a week.

2. Publications (*All acknowledged the current AAOF support)***:**

Pan, H.C., Lee, S., Ting, K., Shen, J., Wang, C., Nguyen, A., Berthiaume, E.A., Zara, J.N., Turner, A.S., Seim, H.B. 3rd, **Kwak, J.H.**, Zhang, X., Soo, C. Cyst-like Osteolytic Formations in

Recombinant Human Bone Morphogenetic Protein-2 (rhBMP-2) Augmented Sheep Spinal Fusion. Am J Pathol. 2017 Jul;187(7):1485-1495. doi: 10.1016/j.ajpath.2017.03.010. Epub 2017 May 11. PMID: 28502475.

James, A., Shen, J., Tsuei, R., Nguyen, A., Khadarian, K., Meyers, C.A., Pan, H.C., Li, W., **Kwak, J.H.**, Asatrian, G., Culiat, C., Lee, M., Ting, K., Zhang, X., Soo, C. NELL-1 induces Sca-1-positive mesenchymal progenitor cell expansion in models of bone maintenance and repair. JCI Insight, April 2017. *Accepted for publication.*

Shi, J., Lee, S., Pan, H.C., Mohammad, A., Lin, A., Guo, W., Chen, E., Ahn, A., Li, J., Ting, K., **Kwak, J.H. (Corresponding and senior author)**. Association of Condylar Bone Quality with TMJ Osteoarthritis. Journal of Dental Research 2017. May 1:22034517707515. doi: 10.1177/0022034517707515. PMID: 28476093.

From the NASA project, media coverages were made on over 80 journals including the NY Times and Los Angeles Daily News, in addition to AAO, CASIS and NASA. Links are below for further information:

* NY Times: https://www.nytimes.com/2017/06/02/science/spacex-cargo-international-space-station.html?smid=tw-nytimesscience&smtyp=cur

* Los Angeles Daily News: http://www.dailynews.com/business/20170603/spacex-delivers-11th-payload-to-international-space-station-for-nasa

* AAO: https://www.aaoinfo.org/news/2017/06/aao-member's-bone-study-underway-international-space-station

* Video by CASIS and NASA "ISS National Lab SpaceX CRS-11 Payload Overview: UCLA": https://www.youtube.com/watch?v=PyEn3ao_NRs&feature=youtu.be

* Video by NASA, "Growing Bone in Space": https://www.youtube.com/watch?v=ht9zTT4qPeI&feature=share&app=desktop

3. **Presentations (***All acknowledged the current AAOF support)***:**

(i) Oral presentations

Kwak, J.*, Shi, J., Pan, H.C., Chen, E., Zhang, Y., Lee, S., Ting, K., Wu, B., Soo, C. "Systemic NELL-PEG Therapy: Skeletal effects on the ground and in space". Consortium for Orthodontic Advances in Science and Technology (COAST) - Workshop on "Personalized & Precision Orthodontics". September 2016, West Palm Beach, FL.

Kwak, J.*, Shi, J., Lee, S., Chen, E., Zhang, Y., Pan, H.C., Stodieck, L., Ting, K., Wu, B., Soo, C. "Novel systemic PEGylated NELL-1 therapy for osteoporosis in space". International Space Station (ISS) R&D Conference, July 2016, San Diego, CA.
- Briefing highlighted in ***Upward*** (Issue 3), the quarterly magazine of the ISS National Lab.

(ii) Poster presentations

Shi, J.*, Lee, S., Pan, H.C., Guo, W., Lin, A., Soo, C., **Kwak, J.H. (Senior author)**. Condylar Osteoporosis is Associated with Temporomandibular Joint Arthritis. ASBMR Annual Meeting, September 2016, Atlanta, GA.

4. To what extent have you used, or how do you intend to use, AAOF funding to further your career?

I have used the AAOF OFDFA funding entirely for salary support. This has partially provided me a much needed financial stability, and thus allowed me more time to focus on the proposed career development goals in education, research, teaching, and clinical components.