



# 2012-2013 Research Synopses Biomedical and Tissue Engineering

The **Biomedical and Tissue Engineering Research Group** of the HKU Faculty of Dentistry aims to bridge the gap between basic science research and its clinical application in the field of bone induction (stimulation of bone formation) and dental biomaterials. Below is a selection of summaries of research findings published by the Biomedical and Tissue Engineering Research Group, with online links to abstracts or full papers in *Medline*.

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Zhan X, Zhang CF, Dissanayaka WL, Cheung GSP, Jin LJ, Yang YQ, Yan FH, Tong EHY.

## ***Storage media enhance osteoclastogenic potential of human periodontal ligament cells via RANKL-independent signaling.***

*Dent Traumatol* 2013;29:59-65. <http://www.ncbi.nlm.nih.gov/pubmed/22487464>

■ It is unknown if storing knocked-out teeth in certain liquids before reinsertion affects periodontal ligament cells on roots, which are involved in re-attachment. This laboratory study showed that when human periodontal ligament cells were grown for 1 or 6 hours in milk, Hank's balanced salt solution, or modified Eagle's medium alpha, they caused mouse "RAW 264.7" cells to resemble bone-resorbing cells (osteoclasts). The effect did not use the expected cell signalling mechanism (RANKL pathway) and was greatest if periodontal ligament cells had been grown in milk for 6 hours. The researchers say their method could test if liquids used for storing knocked-out teeth can keep periodontal ligament cells alive.

Zhu XF, Zhang CF, Huang GTJ, Cheung GSP, Dissanayaka WL, Zhu WH.

## ***Transplantation of dental pulp stem cells and platelet-rich plasma for pulp regeneration.***

*J Endod* 2012;38:1604-9. <http://www.ncbi.nlm.nih.gov/pubmed/23146645>

■ These researchers removed all of the deep tissue (pulp) from a total of 16 upper permanent premolars in 4 dogs and filled the root canals with (1) platelet-rich plasma, (2) blood containing stem cells from the dental pulp of incisors, or (3) both; or (4) the root tips were pierced to allow blood to enter and clot. After 12 weeks, new living tissues and bone-like structures had formed in 24 of 32 root canals to a similar extent for all four treatments. Hence, the tissues around the root tip might have been a source of stem cells, the researchers suggest.

*Cheung GSP, Lee AHC, Wong MCM.*

***Suitability of time estimates for survival analysis of endodontic treatment.***

*J Endod* 2013; 39:593-6. <http://www.ncbi.nlm.nih.gov/pubmed/23611374>

■ This analysis of a representative sample of 889 teeth that had undergone root canal treatment revealed which of the recorded dental visit dates best estimated the dates of certain milestones (obtained by Kaplan-Meier survival analysis). The half-way visit date was best for estimating when clinical outcomes happened, especially healing around the root tip (periapical healing), whereas the diagnosis date was best for estimating tooth survival.

*Munro NG, Green DW, McGrath KM.*

***In situ continuous growth formation of synthetic biominerals.***

*Chem Commun (Camb)* 2013;49:3407-9. <http://www.ncbi.nlm.nih.gov/pubmed/23508225>

■ These researchers imitated how the shiny inner surface, or nacre (mother of pearl), of abalone shell forms by continuous self-assembly of minerals. They did this by soaking an insoluble scaffold of a sugar-like compound (chitin or chitosan) in a solution of a protein mimic (poly[acrylic acid]) and minerals (calcium chloride, sodium bicarbonate, and calcium carbonate). Then, the addition of a solution of small sugar-like molecules (chitosan oligomers) promoted mineral build-up to form a structure resembling shell nacre.

*Epasinghe DJ, Yiu CKY, Burrow MF, Hiraishi N, Tay FR.*

***The inhibitory effect of proanthocyanidin on soluble and collagen-bound proteases.***

*J Dent* 2013;41:832-9. <http://www.ncbi.nlm.nih.gov/pubmed/23806340>

■ Adhesives used in dental restorations get weakened by enzymes that degrade the protein collagen in tooth dentine. In this laboratory study, researchers inhibited these enzymes by proanthocyanidin extracted from grape seeds. It inactivated soluble recombinant matrix metalloproteinases 2, 8, and 9 by more than 90% and cysteine cathepsin B and K by more than 70%. It also reduced degradation of dentine samples. All these effects were greater than those achieved by the chemical chlorhexidine, suggesting that proanthocyanidin could be included in dental adhesives to improve their durability.

*Cheung LK, Chua MD, Hariri F, Pow EHN, Zheng LW.*

***Alveolar distraction osteogenesis for dental implant rehabilitation following fibular reconstruction: a case series.***

*J Oral Maxillofac Surg* 2013;71:255-71. <http://www.ncbi.nlm.nih.gov/pubmed/23351759>

■ This report documents the successful results of lower-jaw reconstruction and rehabilitation in five patients. First, a piece of the left calf bone (fibula) was horizontally transplanted into the jaw. The bone was then divided along its length after healing, a mechanical device was attached and used to gradually separate the bone (alveolar distraction osteogenesis) to increase jaw height by an average of about 1.3 cm, and a dental bridge was implanted. All five patients were satisfied with their appearance, biting, and speech.

Liu XL, Cheung LK, Zhang HX, Li JY, Ma L, Zheng LW.

**Comparison of gene expression of tissue inhibitor of matrix metalloproteinase-1 between continuous and intermittent distraction osteogenesis: a quantitative study on rabbits.**

*J Craniomaxillofac Surg* 2012; 40:e185-8. <http://www.ncbi.nlm.nih.gov/pubmed/22093241>

■ Distraction osteogenesis generates new bone when the two ends of a cut bone are gradually separated by a mechanical device. In this study, the ends of a cut in the lower jawbone of rabbits were separated by 0.9 mm each day for 11 days. On days 6 and 10, continuous separation by a motor triggered greater expression (mRNA level) of tissue inhibitor of matrix metalloproteinase-1 (TIMP-1) than stepwise separation by hand. Because TIMP-1 inhibits an enzyme that breaks down the scaffold around bone cells, increased TIMP-1 expression may explain why previous animal studies of distraction osteogenesis showed faster bone healing after motor-driven continuous separation than after manual stepwise separation.

Ogura E, Matsuyama M, Goto TK, Nakamura Y, Koyano K.

**Brain activation during oral exercises used for dysphagia rehabilitation in healthy human subjects: a functional magnetic resonance imaging study.**

*Dysphagia* 2012;27:353-60. <http://www.ncbi.nlm.nih.gov/pubmed/22076444>

■ The brain activity of eight healthy adults was mapped by functional magnetic resonance imaging as they made different mouth movements. Pursing (pouting) or stretching the lips, moving the tongue sideways, protruding the tongue, and rolling a small ball in the mouth with the tongue all activated certain parts of the brain (precentral gyrus and cerebellum). Ball-rolling activated the brain the most, suggesting that people with swallowing problems (dysphagia), such as the elderly, could include ball-rolling exercises during rehabilitation.

Nabil S, Lo RCL, Choi WS.

**Simultaneous radicular cyst and mucoepidermoid carcinoma in the maxilla: a diagnostic nightmare.**

*BMJ Case Rep* 2013; doi: 10.1136/bcr-2013-010290. <http://www.ncbi.nlm.nih.gov/pubmed/23761616>

■ This report of a 20-year-old woman describes the challenges involved in diagnosing a swelling in the roof of the mouth, which was in fact two different conditions at a similar site: a cyst near a tooth root (benign radicular cyst) in the left side of the upper jaw and a tumour (low-grade mucoepidermoid carcinoma) in the left palate. The clinicians recommend that such cases be examined by computed tomography, scanning in thin (1-mm) slices.

Leung YY, Wong WY, Cheung LK.

**Surgical ciliated cysts may mimic radicular cysts or residual cysts of maxilla: report of 3 cases.**

*J Oral Maxillofac Surg* 2012;70:e264-9. <http://www.ncbi.nlm.nih.gov/pubmed/22310457>

■ Three patients were each treated for a benign cyst in the upper jaw, known as a surgical ciliated cyst. All three patients had previously undergone surgery

in the upper jaw region (Caldwell-Luc surgery for maxillary sinusitis, 7, 13, and 26 years earlier), and the procedure had probably led to the trapping of some cells from the airway lining, which then developed into cysts.

*Lung CYK, Kukk E, Matinlinna JP.*

***The effect of silica-coating by sol-gel process on resin-zirconia bonding.***

*Dent Mater J* 2013;32:165-72. <http://www.ncbi.nlm.nih.gov/pubmed/23370886>

■ The compound zirconia requires special surface treatment, such as silica coating followed by silane coating, to bond to the resin-composite part of some dental restorations. This experimental study compared two methods of silica coating and found that a “sol-gel” process using a solvent mixture containing silica led to weaker bonding to resin than sandblasting with silica-coated alumina particles, which is the conventional process used in dental laboratories.

*Liu D, Matinlinna JP, Tsoi JKH, Pow EHN, Miyazaki T, Shibata Y, Kan CW.*

***A new modified laser pretreatment for porcelain zirconia bonding.***

*Dent Mater* 2013;29:559-65. <http://www.ncbi.nlm.nih.gov/pubmed/23537570>

■ Zirconia requires special surface treatment to bond to the porcelain (ceramic) part of some dental restorations. This experimental study found that compared with no zirconia surface treatment, a new technique using a carbon-dioxide laser beam increased the strength of bonding between zirconia and porcelain, and to a similar extent as sandblasting with alumina particles.

*Gunarajah DR, Samman N.*

***Biomaterials for repair of orbital floor blowout fractures: a systematic review.***

*J Oral Maxillofac Surg* 2013;71:550-70. <http://www.ncbi.nlm.nih.gov/pubmed/23422151>

■ This review of the scientific literature published in English identified 19 different types of implant materials that were used to repair bone fractures in the base of the eye socket in 2483 patients. Although noting most of the 55 studies presented low-level evidence, the reviewers conclude that “all graft materials used were successful to variable degrees” and that the main factor in deciding which material to use is the size of the fracture.

*Yang YQ, Tan YY, Wong RWK, Wenden A, Zhang LK, Rabie AB.*

***The role of vascular endothelial growth factor in ossification.***

*Int J Oral Sci* 2013;4:64-8. <http://www.ncbi.nlm.nih.gov/pubmed/22722639>

■ This review of relevant literature in the PubMed database concludes that vascular endothelial growth factor (VEGF) stimulates bone formation through multiple mechanisms. Not only does it have a role in blood vessel formation and hence delivery of cells needed in bone formation (mesenchymal cells), but it is also involved in various direct aspects of bone development.

*Jayaratne YSN, Deutsch CK, McGrath CPJ, Zwahlen RA.*

***Are neoclassical canons valid for southern Chinese faces?***

*PLoS One 2013;7:e52593. <http://www.ncbi.nlm.nih.gov/pubmed/23285105>*

■ After analyzing facial proportions in 103 Hong Kong Chinese young adults without any obvious facial deformities, these researchers recommend abandoning certain traditional western ideals (neoclassical canons) in aesthetics, such as when planning facial surgery for southern Chinese people. For example, none of the faces showed that the distance between the eyes was equal to the width of an eye, only about 9% showed the width of the mouth was 1.5 times the width of the nose, and 19% showed the width of the nose was equal to the distance between the eyes.

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