Nantes, 27 october 2015

9h-18h Faculté de Chirurgie Dentaire
Place Alexis Ricordeau

LIOAD Laboratoire d'Ingénierie Ostéo-Articulaire et Dentaire
Région PAYS DE LA LOIRE
Instituts thématiques Inserm Institut national de la santé et de la recherche médicale
SFR - Santé F. Bonamy
UNIVERSITÉ DE NANTES

BBC meeting

1st edition

Basic research on Bone and Cartilage biology

KEYNOTE SPEAKERS

Florent Elefteriou (Nashville, USA)
"ECM mineralization defects as the etiology of NF1 tibia bowing and pseudarthrosis"

Valérie Geoffroy (Paris, France)
"microRNAs control osteoformation, and beyond"

Christa Maes (Leuven, Belgium)
"Regulation of bone formation and homeostasis by cell-intrinsic signalling molecules in osteoprogenitors"

Laurent Beck (Nantes, France)
"PiT1 and PiT2 in skeleton biology"

Graham Williams/Duncan Bassett (London, UK)
"The Origins of Bone and Cartilage Disease Project"

Laurence Legeai-Mallet (Paris, France)
"Achondroplasia - new therapy"

Francis Berenbaum (Paris, France)
"Osteoarthritis : the Joint-Brain Axis"

Reinhold Erben (Vienna, Austria)
"Endocrine and Paracrine actions of FGF23"

Nicola C Partridge (New York, USA)
"Recent aspects of PTH biology"

Franck Oury (Paris, France)
"Osteocalcin and skeletal formation"

ORGANIZERS

Laurent Beck
Sarah Beck-Cormier
Carole Gauthier
Valérie Pecqueret
Sophie Source
Mélanie Verron

state-of-the-art conference
free registration
interactive and informal format
USA - United kingdom
Austria - Belgium - France

http://www.BBC-meeting.com

8h30-8h55	Registration and coffee
8h55-9h00	Welcome
9h00-9h40	**Florent Elefteriou** (Vanderbilt Center for Bone Biology, Nashville, USA) *"ECM mineralization defects as the etiology of NF1 tibia bowing and pseudarthrosis"*
9h40-10h20	**Valérie Geoffroy** (Inserm U1132 Bioscar, Paris, France) *"microRNAs control osteoformation, and beyond"*
10h20-10h40	Coffee break
10h40-11h20	**Christa Maes** (Skeletal Biology and Engineering Research Center, Leuven, Belgium) "Regulation of bone formation and homeostasis by cell-intrinsic signalling molecules in osteoprogenitors"
11h20-12h00	**Laurent Beck** (Inserm U791 LIOAD, Nantes, France) "PiT1 and PiT2 in skeleton biology"
12h00-13h30	Lunch
13h30-14h10	**Graham Williams/Duncan Bassett** (Imperial College, London, UK) "The Origins of Bone and Cartilage Disease Project"
14h10-14h50	**Laurence Legeai-Mallet** (Institut Imagine, Paris, France) "Achondroplasia: new therapy"
14h50-15h30	**Francis Berenbaum** (Centre de recherche Saint-Antoine, Paris, France) "Osteoarthritis : the Joint-Brain Axis"
15h30-15h50	Coffee break
15h50-16h30	**Reinhold Erben** (University of Veterinary Medecine, Vienna) "Endocrine and paracrine actions of FGF23"
16h30-17h10	**Nicola C Partridge** (Center for Skeletal and Craniofacial Biology, New York) "Recent aspects of PTH biology"
17h10-18h00	**Franck Oury** (Institut Necker Enfants Malades, Paris, France) "Osteocalcin and skeletal formation"
18h00	Final words

ECM mineralization defects as the etiology of NF1 tibia bowing and pseudarthrosis

Florent Elefteriou. Vanderbilt Center for Bone Biology, Nashville, USA

Dr. Florent Elefteriou's research program aims at understanding the biological mechanisms that control bone development, remodeling, repair and cancer metastasis, with the goal to develop novel therapeutic strategies preventing or treating skeletal diseases. The first focus area in his laboratory is related to the etiology of the skeletal maladies in individuals with neurofibromatosis type I (NF1). His work, mainly based on the use of genetically modified mice, demonstrated that the skeletal defects associated with NF1 result from primary osseous abnormalities of endochondral bone formation, caused by loss of *Nf1* function in osteochondroprogenitor cells. It also identified several molecular targets of neurofibromin signaling that are currently used for the design of novel targeted therapeutic strategies to improve bone mass, strength and bone repair in children with NF1. This is a very translational area of research, which is currently transitioning to clinical directions in collaboration with orthopaedic surgeons and the industry (Alexion, Biomarin).

The second major focus area of Dr. Elefteriou's laboratory is the influence of the autonomic nervous system as regulator of bone remodeling and bone cancer metastasis, with a particular focus on the role of the endogenous sympathetic and parasympathetic nervous systems in the regulation of bone homeostasis. Current efforts of the laboratory aim at addressing the biological and clinical relevance of our previous findings, which led us to study conditions including aging, chronic stress and depression and their impact on bone remodeling and breast cancer metastasis.

Dr. Elefteriou is currently Associate Professor at Baylor College of Medicine, Houston, TX, in the Department of Human and Molecular Genetics and Orthopedic Surgery. He also serves as the Associate Director of the Center for Skeletal Medicine and Biology in Houston.

microRNAs control osteoformation, and beyond

Valérie Geoffroy. Inserm U1132 Bioscar, Paris, France

The global aim of “osteoformation” team, headed by Valérie Geoffroy is to characterize the regulation of bone formation and the control of bone mass. Its specific aim is to characterize the different levels of gene regulation and their possible cross-talk in the osteoblast.

Valérie Geoffroy has recently identified a new alternative for the regulation of osteoblast differentiation that involves microRNAs, and has found that Runx2, the key factor of bone development, is central in this new regulatory mechanism. One of them, miR-199, is expressed at high levels in mature osteoblasts and in osteocytes isolated from cortical bone, and displays strong osteogenic activities in vitro and in vivo. These results together with previously published data indicate that miR-199 is not only capable of regulating osteoblast differentiation in vitro but could also control bone mass accrual in vivo.

Regulation of bone formation and homeostasis by cell-intrinsic signalling molecules in osteoprogenitors

Christa Maes. Skeletal Biology and Engineering Research Center, Leuven, Belgium.

The Laboratory for Skeletal Cell Biology and Physiology (SCEBP) studies the mechanisms underlying the formation of bone in various settings, ranging from fetal skeletal development and juvenile growth to adult bone homeostasis and disease, and the repair of bone defects. Thorough insights into how healthy bones are built during embryogenesis and maintained in adult life are key to the development of new osteo-anabolic therapies, which are much needed for treatment of widespread bone diseases such as osteoporosis and compromised fracture healing. Therefore, the primary goal of the research program of our group is to gain novel insights in the cell biology of the bone-forming osteoblasts.

We currently focus particularly on the migration, adhesion and positioning of osteogenic precursor cells and the interplay between these cells and their microenvironment, including interactions with other cell types such as the endothelial cells of the bone and marrow vasculature. Using genetically altered mice as model organism, and combining various in vivo, in vitro and molecular methodologies, we investigate candidate mechanisms regulating these processes in skeletal precursors and osteoblasts and assess their significance for bone physiology and regeneration.

An increased understanding of the mechanisms responsible for the correct generation, spatial organization and functioning of bone-producing osteoblasts will hopefully contribute to the identification of new targets for the development of anabolic treatments of osteoporosis and other bone disorders, and to improve bone regenerative tissue engineering strategies.

Recent reviews:

- Dirckx, N, Van Hul, M, Maes, C. (2013). Osteoblast recruitment to sites of bone formation in skeletal development, homeostasis, and regeneration. Birth Defects Research C, Embryo Today, 99 (3), 170-191.
- Maes C. (2013). Role and regulation of vascularization processes in endochondral bones. Calcif Tissue Int. 92: 307-323.

PiT1 and PiT2 in skeleton biology

Laurent Beck. Inserm U791, LIOAD, Nantes, France.

Skeletal mineralization is a ubiquitous process in the animal kingdom and is fundamental to human development and health. During this process, calcium and phosphate (Pi) are required for the formation of apatite crystals that will be deposited on the collagenous extracellular matrix (ECM), secreted by mineralizing osteoblasts and chondrocytes. In the absence of these ions, or in case of abnormal absorption or reabsorption, bone mineralization is impaired. Despite their requisite function in building bone and decades of research, the precise role osteoblasts and chondrocytes play in mediating apatite formation remains unclear. Particularly, the identity and possible role of Pi transporters in apatite formation and skeletal mineralization is unknown.

PiT1 and PiT2 are members of the SLC20 family of sodium-coupled Pi transporters and are the only Pi transporters expressed in skeletal tissues. The originally described function of PiT1 and PiT2 as Pi transporters has led to the early hypothesis that they represent essential suppliers of Pi for apatite formation.

Through the use of genetically modified mice, we have challenged this hypothesis. Our data show that partial depletion of PiT1 in mice elicited a post-natal mineralization retardation, rapidly compensated with age, leading to normal bone formation and mineralization in adult mutants. Moreover, conditional invalidation of PiT1 in bone-forming cells using the Osx-CreERt2$^{tg/+}$ mice confirmed these findings, and we recently demonstrated that deletion of PiT1 in cartilage using the Col2-Cre mice have very little impact on the matrix vesicle-mediated mineralization process. On the other hand, we showed that PiT2 KO mice displayed growth retardation, decrease in bone mineral density and impaired growth plate maturation. Interestingly, recent preliminary data using primary cultures of PiT2 KO chondrocytes and osteoblasts suggest that defects of bone formation in the mutant mice may not only be due to defects in the skeletal lineage.

In line with this observation, it is striking to note that PiT1 and PiT2 are highly expressed in vessels, that PiT1 is regulated by major angiogenic factors (PDGF, TGFß, IGF-I, FGF-2, BMP2) and that invalidation of PiT1 in mice leads to an impairment of the yolk sac vasculature. Consistently, we recently showed that conditional deletion of PiT1 in chondrocytes using the AcanCreERt2$^{tg/+}$ mice impairs VEGF-A secretion leading to loss of cell survival and decreased CD31 signal in the surrounding cartilage. Moreover, preliminary data using barium sulfate-injection in PiT2 KO mice suggests that the vascular network is abnormal in the kidney and tibia of mutant mice.

Our data is then challenging the simplified hypothesis of PiT as suppliers of Pi for apatite formation and raises the question whether their physiological role in the skeleton may relate to bone angiogenesis.

The Origins of Bone and Cartilage Disease: high throughput bone phenotype screen to identify new genes that determine bone structure and strength

Duncan Bassett and **Graham R Williams**. Molecular Endocrinology Group, Department of Medicine, Imperial College London

Bone mineral density is a quantitative trait with 60-90% heritability, 3% of which is accounted for by known genetic variation. The Origins of Bone and Cartilage Disease (OBCD) initiative is an international consortium identifying new genes involved in the pathogenesis of skeletal disease. We developed and validated a rapid-throughput skeletal phenotyping screen based on imaging and biomechanical testing that includes both structural and functional approaches. 1500 International Mouse Phenotyping Consortium (IMPC) knockout mouse lines will be screened over 5 years to identify those with significantly abnormal bone structure and function.

Bone mineral content and bone length are determined by digital X-ray microradiography (Faxitron MX-20), BMD and cortical and trabecular bone 3D microarchitecture by micro-CT (Scanco MicroCT-50), and bone strength by destructive three-point bend testing of femurs and compression testing of vertebrae (Instron-5543 load frame). C57BL6/N strain-specific reference ranges have been established for all parameters using samples from 16 week-old female wild-type mice (n=94). Thus, samples (left femur, 6-7th caudal vertebrae) from only 2 individual 16 week-old female mice per knockout line are required to identify significant outlier phenotypes with parameters >2SD outside the reference range.

To date we have completed analysis of 233 unselected knockout lines and identified 18 with major abnormalities of both bone structure and strength. One, *Sparc* $^{tm1aWtsi/tm1aWtsi}$, targets the bone matrix protein osteonectin. *Sparc* knockout mice had previously and independently been generated and were reported to have osteopenic, brittle bones. These findings were replicated in the OBCD screen validating our approach. The other 17 lines target genes not previously associated with skeletal disorders. Six lines have a high bone mass phenotype including *Uevld*$^{tm1aWtsi/tm1aWtsi}$ and *Usp11*$^{tm1Wtsi/tm1Wtsi}$, both genes involved in the ubiquitination conjugation pathway. The other 11 lines have a low bone mass phenotype, including *Daam2*$^{tm1Wtsi/tm1Wtsi}$, a component of the WNT/PCP pathway, and *Agap1*$^{tm1aWtsi/tm1aWtsi}$, which is involved in the regulation of endocytosis. These studies demonstrate that skeletal phenotyping of a large series of unselected knockout mice can rapidly identify new genetic determinants of skeletal disease.

Achondroplasia-new therapy

Laurence Legeai-Mallet. Institut Imagine, INSERM U1163, Université Paris Descartes, Paris, France

Fibroblast growth factor receptor 3 (FGFR3) is an important regulator of bone formation. Achondroplasia (ACH) is the most common form of dwarfism; it involved *FGFR3* gene mutations, in which skull, appendicular and axial skeletons are affected. The comparative analyses of the skeletal phenotype of *Fgfr3* mice (*Fgfr3*$^{Y367C/+}$) and patients with ACH showed, in both cases, short stature, defective proliferation and differentiation of the chondrocytes in the growth plate cartilage, skull base anomalies with a complete absence of the synchondrosis and a reduction of the size of the occipital foramen. Both endochondral and membranous ossification processes are disrupted during development in ACH and *Fgfr3*$^{Y367C/+}$mice. At cellular level, *Fgfr3* gainoffunction mutations induce increased phosphorylation of the tyrosine kinase receptor FGFR3; which correlated with an enhanced activation of its downstream signaling pathways.

Potential therapeutic strategies have emerged for ACH. Several preclinical studies have been carried out: CNP (C-type natriuretic peptide) analog (BMN111), intermittent PTH injections, soluble FGFR3 therapy, Meclozine and Statin treatments. More recently, the improvement the whole skeleton and the skull anomalies was also demonstrated with the pan-FGFR tyrosine kinase inhibitor (NVP-BGJ398).

Among the putative targets to antagonize FGFR3 signaling, CNP (or BMN111) is one of the most promising strategies. BMN111 acts as a key regulator of longitudinal bone growth by down-regulating the MAPK pathway, which is activated as a result of *FGFR3* gain-of-function mutation. Preclinical studies showed that BMN 111 treatment led to a large improvement in skeletal parameters in *Fgfr3*$^{Y367C/+}$mice

Today, BMN111 (vosoritide) is currently in clinical trial (phase 2) in pediatric patients with ACH. The first data show the improvement of the growth velocity in children with ACH and support the further development of vosoritide for the treatment of children with achondroplasia with open growth plates.

Osteoarthritis: the Joint-Brain Axis

Francis Berenbaum. Centre de recherche Saint-Antoine, Paris, France

Osteoarthritis has long been considered as a joint disease influenced by local factors only (such as overload, joint trauma or anatomical deformities) which would trigger cartilage, subchondral bone and synovial cells activation leading to the release of degradative mediators eventually destroying the matrix. More recently, observational and interventional experimental studies have shown that a systemic low-grade inflammation component could play an additional role, at least in a subgroup of OA patients suffering from metabolic diseases like obesity, diabetes mellitus, lipid abnormalities or hypertension. Because of the recent knowledge about close connections between inflammation, metabolic diseases and the brain, the influence of nervous system pathways on initiation and/or progression of OA could be considered, too. In this lecture, these potential pathways involved in communications between OA joints and the nervous system will be presented. The role of the circadian rhythms and of the autonomic nervous system on the pathophysiology of OA will be particularly developed.

Such an integrative vision of the OA process is changing our paradigm by including OA in the list of the metabolic diseases influenced by the brain. If confirmed, this hypothesis could be a breakthrough for the future treatments of OA, by seeking new targets modulating these pathways. A cross-cutting approach of the pathophysiology of the disease seems now inevitable for a step-forward in treating OA in the future.

Endocrine and auto-/paracrine actions of FGF23

Reinhold G. Erben. Dept. of Biomedical Sciences, University of Veterinary Medicine, Vienna, Austria.

Fibroblast growth factor-23 (FGF23) is a bone-derived hormone, mainly produced by osteoblasts and osteocytes in response to increased extracellular phosphate and circulating vitamin D hormone. Endocrine FGF23 signaling requires co-expression of the ubiquitously expressed fibroblast growth factor receptor 1c (FGFR1c) and the co-receptor α-*Klotho* (Klotho). In renal proximal tubules, FGF23 suppresses the membrane expression of the type II sodium-phosphate cotransporters Npt2a and Npt2c which are necessary for the urinary reabsorption of phosphate. In addition, FGF23 suppresses the renal proximal tubular expression of 1α-hydroxylase, the key enzyme responsible for vitamin D hormone production. In renal distal tubules, FGF23 signaling activates with-no-lysine kinase 4, leading to increased renal tubular re-absorption of calcium and sodium. Therefore, FGF23 is not only a phosphaturic, but also a calcium- and sodium-conserving hormone. Besides these endocrine, Klotho dependent functions of FGF23, we recently discovered that FGF23 is also an auto-/paracrine suppressor of tissue nonspecific alkaline phosphatase (*TNAP)* transcription via Klotho-independent FGF receptor-3 (FGFR3) signaling, leading to local inhibition of mineralization through accumulation of the TNAP substrate pyrophosphate. Hence, FGF23 is not only an endocrine factor regulating mineral homeostasis, but also an auto-/paracrine regulator of bone mineralization.

Recent Aspects of PTH Biology

Nicola C. Partridge. Department of Basic Science and Craniofacial Biology, New York University College of Dentistry, New York, NY.

Parathyroid hormone acts through the PTH1R in bone which belongs to the family of G-protein coupled receptors, and activation of the receptor by PTH initiates a cascade of intracellular signaling pathways primarily through heterotrimeric G proteins ($G_{\alpha\beta\gamma}$). The major G_{α} protein responsible for PTH1R signal transduction is the stimulatory $G_{\alpha s}$. The activated GTP-bound $G_{\alpha}s$ then binds to and activates adenylate cyclase on the cell membrane and stimulates the formation of cAMP. In turn, cAMP binds the regulatory subunits of protein kinase A (PKA) to release the catalytic subunits of the enzyme. The catalytic subunits of PKA phosphorylate proteins on serine or threonine residues causing changes in structure and function of several proteins, particularly in transcription factors such as Runx2, Mef2c and cAMP-response element-binding protein or in repressor proteins, such as histone deacetylase-4 and -5. Alternatively, ligand binding with PTH1R also leads to activation of $G_{\alpha q}$. This stimulates the activity of phospholipase Cβ to break down phosphatidylinositolbisphosphate to diacylglycerol and to 1,4,5-inositol trisphosphate. As a result, cytosolic Ca^{2+} is increased and protein kinase C is activated. In addition, PTH1R activates $G_{\alpha 12/13}$. This stimulates RhoA/Rho kinase and phospholipase D activities in osteoblastic cells. Currently, cAMP/PKA is the main route to transduce PTH/PTH1R signaling in osteoblastic cells because most PTH-regulated genes and the major physiological actions of PTH are mediated through this pathway. PTH (1–34) and PTH (1–31), a truncated PTH analog that activates cAMP/PKA but not the PKC pathway, differentially regulate some 1,000 genes in bone after PTH injection into rats. Only about 40 genes are regulated by PTH (3–34), which activates PLC/PKC and induces intracellular calcium signaling, but not the cAMP/PKA pathway. Intermittent injection of PTH as an anabolic agent stimulates both bone formation and resorption with the effect on formation greater than on resorption, leading to a net gain in bone mass. Extensive investigations have been carried out to understand the cellular and molecular mechanisms by which intermittent injection of PTH increases osteoblast numbers. Multiple cellular mechanisms, including activation of bone lining cells, stimulation of osteoblast differentiation, and prevention of osteoblast apoptosis, contribute to the anabolic action of PTH. At the molecular level, the activation by PTH of distinct pathways indicates that $G_{\alpha s}$/cAMP/PKA is the major route for its anabolic action. The PTH-regulated genes have broad functions, stimulating growth factors and cytokines, signal transducers, structural molecules, transcription factors, transporters, and enzymes. Identification of genes that respond to PTH and study of knockout mouse models of some of these genes together confirm that the anabolic action of PTH requires the expression of many genes. These genes include sclerostin, insulin-like growth factor-1, epidermal growth factor receptor ligands, interleukin-18, monocyte chemoattractant protein-1, fibroblast growth factor-2, transforming growth factor-β1, secreted frizzled related protein-1, c-fos, Runx2, activating transcription factor 4, cAMP response element modulator, bcl-2, connexin-43 and β-arrestin2. In most cases, these genes are regulated by

the cAMP/PKA pathway and transcription either through a primary or a secondary response. This indicates that PTH influences many processes in osteoblasts and osteocytes to produce its physiological functions in bone.

Thank you very much to be here

and see you for the 2nd

;-)

PARTICIPANTS

Pierre AVRIL
LPRO - INSERM UMR957
Nantes
pierre.avril@univ-nantes.fr

Claire BARDET
Université Paris Descartes
Faculté de Chirurgie Dentaire
claire.bardet@parisdescartes.fr

Duncan BASSETT
Imperial College
London
d.bassett@imperial.ac.uk

Laurent BECK
Inserm U791, LIOAD
Nantes
laurent.beck@inserm.fr

Sarah BECK
Inserm U791, LIOAD
Nantes
sarah.beck@univ-nantes.fr

Stéphanie BEQ
Alexion R&D France
Paris
BeqS@alxn.com

Francis BERENBAUM
Hôpital Saint-Antoine
Paris
Francis.Berenbaum@sat.ap-hop-paris.fr

Kevin BITEAU
LPRO - INSERM UMR957
Nantes
kevin.biteau@univ-nantes.fr

Frédéric BLANCHARD
LPRO - INSERM UMR957
Nantes
frederic.blanchard@univ-nantes.fr

Nina BON
Inserm U791, LIOAD
Nantes
nina.bon@univ-nantes.fr

Marie-Astride BOUTET
LPRO - INSERM UMR957
Nantes
boutet.marie-astride@univ-nantes.fr

Cécile BOYER
Inserm U791, LIOAD
Nantes
cecile.boyer@univ-nantes.fr

Meadhbh BRENNAN
LPRO - INSERM UMR957
Nantes
meadhbh.brennan@univ-nantes.fr

Anne CAMUS
Inserm U791, LIOAD
Nantes
anne.camus@univ-nantes.fr

Caroline CARVALHO
Inserm U1163, Institut Imagine
Paris
caroline.carvalho@inserm.fr

Cherifi CHAHRAZAD
Inserm U1132
Paris
cherifichahrazad@gmail.com

Martine COHEN-SOLAL
Inserm U1132
Paris
martine.cohen-solal@inserm.fr

Céline COLNOT
Inserm U1163, Institut Imagine
Paris
celine.colnot@inserm.fr

Pauline COLOMBIER
Inserm U791, LIOAD
Nantes
pauline.colombier@univ-nantes.fr

Maxence CORNILLE
Institut Imagine
Paris
maxencecornille@institutimagine.org

Greig COUASNAY
Inserm U791, LIOAD
Nantes
greig.couasnay@yahoo.fr

Amélie COUDERT
Inserm U1138
Paris
amelie.coudert@upmc.fr

Léa COULON
UTE-IRS-UN
Nantes
marie.liabeuf@univ-nantes.fr

Cyril D'ARROS
Inserm U791, LIOAD
Nantes
cyril.d-arros@inserm.fr

Emilie DAMBROISE
Inserm U1163, Institut Imagine
Paris
emilie.dambroise@institutimagine.org

Geoffroy DANIEAU
LPRO - INSERM UMR957
Nantes
geoffroy.danieau@etu.univ-nantes.fr

Oriane DELAGENESTE
Inserm U1163, Institut Imagine
Paris
oriane.duchamp-de-la-geneste@inserm.fr

Claire-Sophie DEVIGNES
Inserm U1163, Institut Imagine
Paris
claire-sophie.devignes@inserm.fr

Maeva DUTILLEUL
Inserm U791, LIOAD
Nantes
maeva.dutilleul@univ-nantes.fr

Florent ELEFTERIOU
Vanderbilt University
USA
florent.elefteriou@vanderbilt.edu

Reinhold ERBEN
Vienna University
Austria
Reinhold.Erben@vetmeduni.ac.at

Valérie GEOFFROY
Inserm U1132
Paris
valerie.geoffroy@inserm.fr

Maude GLUAIS
Inserm U791, LIOAD
Nantes
maude.gluais@univ-nantes.fr

Marjorlaine GOSSET
Ea2496
Université Paris Descartes
marjolaine.gosset@parisdescartes.fr

Jérôme GUICHEUX
Inserm U791, LIOAD
Nantes
jerome.guicheux@inserm.fr

Boris HALGAND
Inserm U791, LIOAD
Nantes
boris.halgand@univ-nantes.fr

Eric HAY
Inserm U1132
Paris
eric.hay@inserm.fr

Nina HENRY
Inserm U791, LIOAD
Nantes
nina.henry@univ-nantes.fr

Marie Alice HILLERITEAU
LPRO - INSERM UMR957
Nantes
ma.hilleriteau@yahoo.fr

Camille JACQUES
LPRO - INSERM UMR957
Nantes
camille.jacques@univ-nantes.fr

Fédéric JEHAN
Inserm U1132
Paris
frederic.jehan@inserm.fr

Fabienne JORDANA
Inserm U791, LIOAD
Nantes
fabienne.jordana@univ-nantes.fr

Anais JULIEN
Inserm U1163, Institut Imagine
Paris
anais.julien@inserm.fr

David KOMLAEBRI
Institut Imagine
Paris
davidesk.komlaebri@gmail.com

Alain KOUADIOAYEPA
Université de Nantes
Faculté d'odontologie
ayepa_alain@yahoo.fr

Olivier LAPERINE
Inserm U791, LIOAD
Nantes
olivier.laperine@univ-nantes.fr

Pierre LAYROLLE
LPRO - INSERM UMR957
Nantes
pierre.layrolle@inserm.fr

Laurence LEGEAI-MALLET
Inserm U1163, Institut Imagine
Paris
laurence.legeai-mallet@inserm.fr

Laurent LESCAUDRON
Inserm U791, LIOAD
Nantes
laurent.lescaudron@univ-nantes.fr

Philippe LESCLOUS
Inserm U791, LIOAD
Nantes
philippe.lesclous@univ-nantes.fr

Julie LESOEUR
Inserm U791, LIOAD
Nantes
julie.lesoeur@univ-nantes.fr

Elodie LETILLY
Inserm U791, LIOAD
Nantes
elodie.letilly@univ-nantes.fr

Marie LIABEUF
UTE-IRS-UN
Nantes
marie.liabeuf@univ-nantes.fr

Christa MAËS
Skeletal biology and Engineering Research Center
Leuven
christa.maes@med.kuleuven.be

David MAGNE
ICBMS UMR5246 CNRS
Université de Lyon
david.magne@univ-lyon1.fr

Rafik MANSOURI
Inserm U1132
Paris
mansouri_rafik@hotmail.com

Ludovic MARTIN
Inserm U1163, Institut Imagine
Paris
ludovic.martin@institutimagine.org

Christophe MERCERON
Inserm U791, LIOAD
Nantes
christophe.merceron@univ-nantes.fr

Elsa MÉVEL
Inserm U791, LIOAD
Nantes
elsa.mevel@univ-nantes.fr

Sarah MORICE
LPRO - INSERM UMR957
Nantes
sarah.morice1@etu.univ-nantes.fr

Brice MOUKENGUE
LPRO - INSERM UMR957
Nantes
brice.moukengue@etu.univ-nantes.fr

Hayat MUHAMMAD
Inserm U1163, Institut Imagine
Paris
hayat.muhammad@inserm.fr

Richard PACE
Inserm U791, LIOAD
Nantes
richard.pace@univ-nantes.fr

Nicola C PARTRIDGE
Basic Science and Craniofacial Biology
New York university, Dentistry
ncp234@nyu.edu

Anne POLIARD
Université Paris Descartes
Faculté de Chirurgie Dentaire
anne.polliard@parisdescartes.fr

Zocko ange desire POCKPA
UIC11 Faculté d'odontologie
Nantes
angepockpa2013@gmail.com

Elisabeth PORCHER
Atlantic Bone Screen
elisabeth.porcher@atlantic-bone-screen.com

Sylvain PROVOT
Inserm U1132
Paris
sylvain.provot@inserm.fr

Françoise REDINI
LPRO - INSERM UMR957
Nantes
francoise.redini@univ-nantes.fr

Sarah RENAULT
LPRO - INSERM UMR957
Nantes
sarah.renault@iuniv-nantes.fr

Nathalie RENEMA
LPRO - INSERM UMR957
Nantes
nathalie.renema@univ-nantes.fr

Sophie SOURICE
Inserm U791, LIOAD
Nantes
sophie.sourice@univ-nantes.fr

Elise VERRON
Inserm U791, LIOAD
Nantes
elise.verron@univ-nantes.fr

Luciano VIDAL
LPRO - INSERM UMR957
Nantes
luciano.vidal75@gmail.com

Claire VINATIER
Inserm U791, LIOAD
Nantes
claire.vinatier@univ-nantes.fr

Pierre WEISS
Inserm U791, LIOAD
Nantes
pierre.weiss@univ-nantes.fr

Graham WILLIAMS
Imperial College
London
graham.williams@imperial.ac.uk

Mylène ZARKA
Inserm U1132
Paris
mylene.zarka@inserm.fr