Research evaluation

EVALUATION REPORT OF THE UNIT

B3OA – Biologie, bioingénierie et bioimagerie ostéo-articulaires

UNDER THE SUPERVISION OF THE FOLLOWING ESTABLISHMENTS AND ORGANISMS:

Université Paris Cité,
Centre national de la recherche scientifique – CNRS,
École nationale vétérinaire d'Alfort – EnvA,
Institut national de la santé et de la recherche médicale – Inserm

EVALUATION CAMPAIGN 2023-2024

GROUP D

Rapport publié le 05/04/2024

In the name of the expert committee[1] :

Ivan Martin, Chairman of the committee

For the Hcéres[2] :

Stéphane Le Bouler, acting president

Pursuant to Articles R. 114-15 and R. 114-10 of the French Research Code, evaluation reports drawn up by expert committees are signed by the chairmen of these committees and countersigned by the President of Hcéres.

To make the document easier to read, the names used in this report to designate functions, professions or responsibilities (expert, researcher, teacher-researcher, professor, lecturer, engineer, technician, director, doctoral student, etc.) are used in a generic sense and have a neutral value.

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

MEMBERS OF THE EXPERT COMMITTEE

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Ms Marie-Paule Roth

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Ms Christine Guillard, Université Paris Cité
Mr Pierre-Emmanuel Rautou, UFR Médecine, Université Paris Cité
Mr Renaud Tissier, Ecole Vétérinaire Alfort

CHARACTERISATION OF THE UNIT

- Name: Biologie, bioingénierie et bioimagerie ostéo-articulaires
- Acronym: B3OA
- Label and number: UMR CNRS 7052 Inserm 1271 ENVA UPC
- Composition of the executive team: Hervé PETITE, Director

SCIENTIFIC PANELS OF THE UNIT

SVE Sciences du vivant et environnement
SVE6 Physiologie et physiopathologie humaine, vieillissement

THEMES OF THE UNIT

During the 2017–2022 period, the overarching objective of the unit was to develop innovative strategies for the diagnosis, surgical treatment and rehabilitation of patients with orthopaedic-related disorders. There are three themes. The first theme focuses on fundamental, pathophysiological aspects of bone repair (e.g. in type 2 diabetes mellitus). The second theme is dedicated to developing new therapeutics for bone repair (e.g. improving survival of osteoprogenitor cells upon transplantation and introducing innovative material scaffolds). The third theme focuses on developing new procedures in clinical research for osteo-articular diseases (e.g. identifying new parameters predictive of bone quality and rehabilitation procedures after total knee arthroplasty).

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

This unit was founded in 1977 as 'Laboratory of Orthopaedic Research' (LOR), affiliated to CNRS. Since 1998, the LOR merged with three other laboratories, involved in experimental radiology (a part of Paris Diderot University), Biomaterials and polymers (a part of Paris 13 University) and a laboratory of biomechanics (a part of Paris 12 University). This unit was then restructured first in 2008 and then in 2012 by the CNRS-SPI, as the 'Laboratory for Osteo-Articular Bioengineering and Bioimaging' (B2OA). In 2012, this unit was affiliated to the 'École Nationale Vétérinaire de Maisons-Alfort', thanks to the hiring of two veterinary doctors in the unit. The current director has been leading this unit since 2012. The unit is located in the UFR of Medicine of Paris Diderot University.

RESEARCH ENVIRONMENT OF THE UNIT

The B3OA Unit is affiliated to the CNRS, INSERM, Paris Cité University and Ecole Nationale Vétérinaire de Maisons-Alfort. The B3OA's medical staff members are affiliated to AP-HP Nord-UPC, AP-HP Sorbonne, Université, AP-HP Centre-Université de Paris, AP-HP-Université Paris-Saclay.
At university level, the B3OA is integrated into the Institute of Osteoarticular Diseases, Université Paris Cité (IMOA) and the Paris Institute for Transplantation & Organ Regeneration (PITOR).
The B3OA is a funding and/or active unit in an histology platform, the imaging platform – IMOSAR, an hypoxia cell biology technical platform and animal experimentation facilities of the Lariboisière-Villemin site.
The B3OA is involved in the major research and innovation domain (DIM) BioconvS and supported by Erganeo (office for technology transfer).
The B3OA is member of the national groups of research (GDR) Réparer l'Humain and MECABIO. The B3OA is also a member of the France Life Imaging (FLI), a multidisciplinary competence network (radiology, applied mathematics, and image processing) open to the academic, industrial, and clinical communities. Finally, B3OA is involved in the 'Tête et cou' national network implicating health professionals, researchers, and patient associations.

UNIT WORKFORCE: in physical persons at 31/12/2022

Catégories de personnel	Effectifs
Professeurs et assimilés	8
Maîtres de conférences et assimilés	9
Directeurs de recherche et assimilés	2
Chargés de recherche et assimilés	4
Personnels d'appui à la recherche	7
Sous-total personnels permanents en activité	**30**
Enseignants-chercheurs et chercheurs non permanents et assimilés	6
Personnels d'appui non permanents	2
Post-doctorants	0
Doctorants	11
Sous-total personnels non permanents en activité	**19**
Total personnels	**49**

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: in physical persons at 31/12/2022. Non-tutorship employers are grouped under the heading 'autres'.

Nom de l'employeur	EC	C	PAR
CNRS	0	4	6
Inserm	0	2	1
ENVA	3	0	0
UNIVERSITÉ PARIS-CITÉ	2	0	0
AUTRES	2	0	0
Total personnels	**7**	**6**	**7**

GLOBAL ASSESSMENT

During the past reporting period, the Unit has convincingly reacted to the received recommendations and is to be commended for further developing a very good scientific and translational trajectory, which remains of high interest to the institutional representatives. The main established strength and renewed opportunity of the Unit relies on the interdisciplinary engagement of clinicians and scientists with different backgrounds towards developing solid science, aimed at addressing relevant clinical needs in the musculoskeletal space. The Unit is an attractive place for clinicians to be exposed to research and the environment is highly receptive to their integration.

The scientific productivity of the Unit has been very good, in terms of quantity, quality and distribution on different topics, related to both fundamental and clinical research. The main highlights are related to (i) the definition of metabolism-related strategies for improving survival of mesenchymal stroll cells upon implantation, (ii) the development of tools for the controlled delivery of BMP-2 as morphogen for bone repair, (iii) the engineering of materials for glucose delivery and ligament reconstruction, and (iv) the validation of clinical tools for early diagnosis of bone quality. It is recognised that the Unit would have the potential to further develop in quality of scientific production by strategically restricting the priority areas.
The Unit has gained very good attractiveness and visibility in the understanding and treatment of osteoarticular disorders, by offering a distinct scientific environment towards clinical perspectives (e.g. to target bone repair in diabetic patients) and technological developments (e.g. materials for the delivery of cellular therapies). The Unit published 335 papers, with own members as leading authors in 134 (40%) of them and with expectional ratings in 24 (7%) of the cases. The Unit obtained fourteen ANR projects funded (4 as Principal Investigators and 10 as Partners) as well as eleven projects funded by French foundation. No EU-funded project was secured. For the 23 HDR, eleven students defended their PhD thesis. Members of the Unit participated in the organisation of five congresses, including international symposia. The recommended acquisition of postdocs in the Unit and participation to international research programs is expected to continue a positive cycle in attractiveness, which still has to be further developed.
The valorisation of the research work has been very good, thanks to connection with the non-academic sector. Industrial cooperations with 6 companies (e.g. Spineart, ICERAM, Movmedix) have been sketched in different areas (e.g. for the development of advanced materials or diagnostic tools) and have a large potential for more effective exploitation. Two Patents have been filed. Technical infrastructures is adequate for the Unit, but some equipment is obsolete (e.g. the micro-scanner) and it should be considered whether 'omics' technologies (e.g. for metabolomics) should not be strengthened within the unit, rather than relying merely on cooperations.

The main apparent weakness of the Unit is the limited clarity on a strategy to remain internationally competitive in priority areas, reducing the risk to lose focus and dispersed resources into scattered programs. The opportunity of relevant and creative contribution by clinicians, which is unique, should properly filtered and channelled, since otherwise it could undermine scientific depth and strength of the resulting projects. Further efforts should be dedicated in attractiveness and visibility of the Unit, with the goal to establish international consortia eligible for EU funding. The instrument of social channels should be more vigorously adopted towards this aim. The critical mass of the Unit requires to be consolidated with the integration of postdoctoral researchers, to preserve an independent standing, especially in view of upcoming changes in leadership and in structural organisation across institutions.

DETAILED EVALUATION OF THE UNIT

A – CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

1) Recommendations on scientific production and activities: the previous committee encouraged the members of B3OA to publish in the best journals of the discipline of tissue engineering (e.g. Biomaterials) and in 'Osteo-Arthritis' journals for increasing the visibility of the unit in these fields. They also recommended improving interactions with patient associations to go into the development of clinical trials. According to the bibliometric analysis performed by CNRS, the overall number of the B3OA's publications for the 2017-2022 period is 335, including 24 publications rated as exceptional and 63 rated as excellent. This includes publications in Journal of American Medical Association (n=1), American Journal of Transplantation (n=1), Annals of Internal Medecine (n=2), Biomaterials (n=2), Radiology (n=2), Lancet Oncology (n=1), Journal of Controlled Release (n=1), Acta Biomaterialia (n=4), PNAS (n=1), in which the B3OA leadership does not appear predominant. Nevertheless, the publication rate is very high with 3.85 publications/per year/per full-time equivalent. Although two articles have been published in Biomaterials and 4 in Acta Biomaterialia, there are no publications in journals in the field of osteoarthritis (as requested by the past committee). No improvement of interactions with patient associations was mentioned. The communication with the general public should be improved.
The laboratory was not involved in setting up clinical trials. However, B3OA reports the identification of a new parameter, based on skin surface pattern, for the clinical assessment of bone toughness and ductility, and will participate in the validation of its predictive power in terms of bone quality in a database of 10,000 patients from the Radiology department of the Lariboisière Institute.

2) Recommendations on the unit's organisation and life: As recommended by the previous committee, the B3OA attempted to maintain an excellent organisation and life despite the COVID-19 pandemic. The B3OA has also been proactive in the future restructuring of the site by participating in the project of the future Lariboisière Institute (on-site gathering at the Lariboisière hospital of laboratories working in osteoarticular, neurosciences, and critical care medicine research planned for 2030).

3) Recommendations on scientific strategy and projects: As recommended by the previous committee, the B3OA has increased its research director positions. D. Logeart-Avramoglou is now DR2 and H. Petite DR1. Moreover, one CNRS researcher (CR classe normal to CR hors classe), one assistant professor (to full professor), one full professor (2nd to 1st class), one CNRS engineer-assistant (to engineer), one CNRS engineer ('Normal class' to engineer 'exceptional class') and one University Paris 7 technician-assistant to CNRS technician) were promoted. Furthermore, several new recruits have been made to strengthen the laboratory (1 full professor from Ecole Centrale – Lyon, 2 university lecturers/physicians, one CNRS engineer, one INSERM technician, one CNRS assistant engineer (in charge of secretariat/accounting) and 2 CNRS engineers for a temporary 1-year contract).

B – EVALUATION AREAS

Considering the references defined in the unit's evaluation guidelines, the committee ensures that a distinction is made on the outstanding elements for strengths or weaknesses. Each point is documented by observable facts including the elements from the portfolio. The committee assesses if the unit's results are consistent with its activity profile.

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the scientific objectives of the unit

The scientific objectives of the B3OA unit are excellent and well align with the expertise and resources of the unit. The unit has resources that are suited to its activity profile and research environment. The scientific objectives are coherent with the expertise on fundamental topics and clinical research in the lab.

Assessment on the unit's resources

The resources of the unit are very good. The multidisciplinary team of researchers, veterinarians and clinicians are a very good asset. The human resources are adapted in terms of expertise and are adapted to the different research projects. The equipments are sufficient and adequate to perform the objectives. In the following years, the renewal of part of the equipment will likely be necessary.
The researchers and technicians are occupied by administrative work which could be performed by dedicated administrative staff to be recruited.

Assessment on the functioning of the unit

The functioning of the unit is excellent. The PhD students receive the required support and mentoring.
The Café Lab meeting every week allows all the team members to exchange about projects, technical organisation, daily challenges of the unit, etc. All categories of personnel (technician, admin, young and senior researchers) gave positive feedback on the work organisation and communication in the lab. Also the exchange between clinicians and researchers (CNRS/Inserm/Univ) is very positive.

1/ The unit has set itself relevant scientific objectives.

Strengths and possibilities linked to the context

The unit organisation has been structured around the three main scientific themes: fundamental aspects of osteoarticular repair, Translational aspects of osteoarticular repair and Clinical research for osteo-articular disease. The unit is well integrated in the relevant national scientific and clinical societies and the local institutions.
B3OA has a highly positive reputation and enjoys scientific visibility in the field of bone engineering and diseases. The Unit develops a high-level research dedicated to bone surgery and bone repair, with a high level of clinical expertise in orthopedic surgery.
The strengths of B3OA include integration in a clinical osteoarticular environment, orthopedic patient-driven research, procurement of financial resources (that increased throughout the previous term), internal organisation and working conditions quality, career promotion of the collaborators, embedding in scientific and clinical societies and development of technical platforms.
B3OA presents a high level of veterinary involvement with three PI in the previous term (only two in the next one, with possible retirement during the next term), illustrating and promoting the One Health – One Medicine philosophy. The Vet team has a dedicated project about ligament replacement (Project 3 in Theme 2 'Optimization of synthetic ligament for ACL replacement') with a specific task for a veterinary clinical research study. The Vet team also shows a high implication in teaching activities and promotion of the Unit research within the large public and the pet owner audience.

Weaknesses and risks linked to the context

The B3OA has a large number of research activities (e.g. 8 highlighted research projects in their portfolio) with a broad scientific and clinical breath developed into three main topics: Fundamental aspects of osteoarticular repair, Translational aspects of osteoarticular repair, and Clinical research for osteo - articular disease.
Thus, in the context of multiple competitive scientific fields at the international and national levels and the adequacy of the priorities to achieve strong scientific, clinical and societal impacts, the unit may have set the bar high considering the unit organisation and constrained operational capacity (35 staff members, including 25 full-time ones).
B3OA appears aware of the need for restricting the field of research operation to gain depth in focused areas, but the strategy to address this target does not seem clearly defined or presented.

2/ The unit has resources that are suited to its activity profile and research environment and mobilises them.

Strengths and possibilities linked to the context

B3OA is a well-integrated and important Unit in context of the global scientific themes (bone biology and repair, osteoarticular tissue imaging and engineering) of the university and other institutions (CHU-Lariboisiere). It is multidisciplinary and includes integrated contributions of scientists, veterinarians and clinicians. The B3OA is integrated into the osteoarticular and regenerative medicine research ecosystem through its membership in the local IMOA and incoming PITOR off - wall institutes. The B3OA is also well integrated in the French and international ecosystem of osteoarticular research through membership in the Société Française de Biologie des Tissus Minéralisés (SFBTM)), the translational societies (GDR 'Réparer l'Humain', DIM BioconvS, 'Tête et cou' network, TERMIS), and the clinical societies (Société Française d'Orthopédie et de Traumatologie [SOFCOT], Académie nationale de chirurgie, ORS, ESTROT). This integration is also reflected through the responsibilities of some B3OA members in these bodies.
The unit achieved an average annual revenue from recurring allocations of 107 k€ and an average annual revenue from non - institutional funding of 501 k€ during the 2017 - 2022 period. The main sources were national contracts (71%), private contracts with SMEs (13%), and Foundations and local funding agencies (10%). The Unit demonstrate an excellent track record in funding its activities through national funding (>3 M€ from 2017-22). The Unit has a policy to mobilise is financial resource to support promising pilot project that will allow investigators to apply to national and European research funds.
B3OA provides a continuum from basic science to translational research and clinical research, with a high number of clinicians (PU-PH), giving opportunities to develop highly relevant patient-driven research. During the 2017 - 2022 period, eight CNRS, ENVA and INSERM staff members within the B3OA have been promoted. The Unit recruited a full professor (T. Hoc), two university lecturers/physicians (J - C.Auregan and M. Bachy), one CNRS engineer (BAP A) (M. Maroquenne), one INSERM technician (L. Quentin), one CNRS assistant engineer (in charge of secretariat/accounting; E. Guigonnat) and two CNRS engineers for a temporary one - year contract. Thus, the unit has significantly reinforced its permanent staff during the last period.
The B3OA contributed to UPC platform committee, to the creation of three platforms (plateforme d'histologie en résine, Plateforme d' imagerie X - IMOSAR, and Plateau technique de biologie cellulaire en hypoxie); and invested its researchers time into the ethics committee for animal experimentation of the Lariboisière and in the animal welfare body. During the 2017 - 2022 period, a room was set - up to house microscopes and temperature - sensitive equipment and cell culture labs are planned to be renovated and the creation of a physioxic cell culture lab planned. Thus, the unit is therefore planning to adapt its platforms and laboratory space, according to scientific needs highlighted in their research portfolio.

Weaknesses and risks linked to the context

The B3OA 4 affiliations to the CNRS, INSERM, Paris Cité University and Ecole Nationale Vétérinaire de Maisons-Alfort provide a fairly unique multidisciplinary environment, but the consequence may be that the unit impact and visibility within each institution is of lesser weight in comparison to larger units with more resources. The local research environment is very competitive (Institut Pasteur and laboratories in national hospitals and universities working on stem-cell biology, biomaterials, Regenerative Medicine, musculoskeletal tissues – e.g. UMRS 1148, UMR861, UMR1132) with a tendency to create larger units. Thus, the small relative size of the B3OA, 25 full-time permanents, is a challenge to free up significant resources (personnel and financial) to develop its activities and invest in new equipment.
Indeed, a large panel of important pieces of equipment is available in the Unit, but some would have to be renewed or purchased in the next years.
The Unit main financial resources rely mainly on funding from national research bodies (71% of total revenue). European funding are under represented and exploited (6% of total revenue).

3/ The unit's practices comply with the rules and directives laid down by its supervisory bodies in terms of human resources management, safety, environment, ethical protocols and protection of data and scientific heritage.

Strengths and possibilities linked to the context

B3OA complies with the regulations on human resources management and safety, following regulations of supervisory institutions. The protection of scientific assets is taken into consideration and action to improve it is taken, demonstrating the unit commitment to address this issue. The unit provide recommendations regarding environmental impact and sustainability. The unit has organised the exchange on the unit life between the

direction and all staff with regular meetings at all level. There is a continuous improvement of the health and safety conditions driven by the unit. Research policy appears co-constructed by all collaborators, especially during dedicated time in the 'Café-Labo meetings' where decisions are taken on a participative basis.

Weaknesses and risks linked to the context

Several staff members are mentioned retiring during the next term, but it is not clear who, how many of them and the potential consequences for the Unit strategies and organisation. Particularly, the possible retirement of the current director (Hervé Petite), a well-known team leader and senior researcher, challenges the future organisation of the Unit. A 5 m² office space per workplace may be considered as a limitation for the unit development.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

The attractiveness of the unit is very good, especially at the national level.

1/ The unit has an attractive scientific reputation and is part of the European research area.

2/ The unit is attractive because for the quality of its staff support policy.

3/ The unit is attractive through its success in competitive calls for projects.

4/ The unit is attractive for the quality of its major equipment and technical skills.

Strengths and possibilities linked to the context for the four references above

1) Scientific reputation:

The B3OA has a well-established collaboration with a China partner, Pr. Huang of the Ecole Centrale de Pékin (Beihang University) allowing the obtention of four PhD scholarships via the competitive China Scholarship Council.
The B3OA is member of the IMOA Institute of the Université Paris Cité (UPC). The association with the Alfort National Veterinary School is a strength regarding the development of translational research, animal models and veterinary applications of the conducted projects.
Members of the B3OA participated in the organisation of five congresses/international symposium during the evaluation period (Symposium Outils diagnostiques, Filière OSCAR, SOFCOT, séminaire annuel d'Imagerie rhumatologique et orthopédique à Genève Suisse « Résonance — Affidea », Topic Chair Arthroplasty. Orthopaedic Research Society (ORS) Annual Meetings (twice)).

B3OA has national collaborations (ISM — UMR 7287 CNRS, CBM-CNRS UPR4301, BIA — UR1268 INRAE, Mint-INSERM 1066 — CNRS 6021, AFMB- UMR CNRS 7257, CRNL, INSERM U1028 — CNRS UMR5292 — Univ Lyon, Lyon, CEA, INSERM U1292 Biosanté, CBM — CNRS UPR4301, Rmes — INSERM U1229, LVTS-INSERM U1148), but also by the involvement of members in collective responsibilities within the university, the CNRS or in medico-scientific academies. Moreover, the B3OA already has numerous international collaborations, as demonstrated by the 135 publications with international co-authors.

2) Attractiveness for the quality of its staff hosting policy:

During the evaluation period, eleven PhDs were defended. Most of PhD published as first authors (9 of 11). Among the PhD candidates, four are foreign students.

3) Attractiveness because of the recognition gained through its success in competitive calls for projects:
The laboratory obtained national funding with fourteen ANR (4 as Principal Investigators and 10 as partners), two PEPs and eleven projects funded by French foundations (Fondation de l'Avenir, Fondation pour la Recherche

Médicale, Gueules Cassées). This success can be explained by the motivation, visibility, and scientific network of the team, its unique field of expertise, and the presence of end users (clinicians) in the Unit.

4) Attractiveness for the quality of its major equipment and technological skills:

The laboratory has good quality equipment and platforms (in the laboratory or accessible via its partners) enabling research projects to be carried out. This is corroborated by the success in calls for projects (mainly ANR).

Three platforms (Platform for Resin Histology, X-rays imaging platform IMOSAR and Platform of cell biology in Hypoxia) of the laboratory are shared with the academic and scientific national and international community, increasing cost-effectiveness and enhancing the attractiveness, visibility, and competitiveness of the B3OA. However, the obsolescence of some equipments was emphasised during the committee's visit.

Weaknesses and risks linked to the context for the four references above

1) Contribution to the construction of the European research:

B3OA is lacking yet the visibility and impact expected considering the scientific dimension of the unit (e.g. EU research projects, clinical trials at European levels). The COVID period has restricted international exchange, as a relevant way to improve visibility and collaboration at an international level and to increase the unit capacity to apply to international funding agencies. There is no participation in international research networks and limited membership in international society committees.

2) Attractiveness for the quality of its staff hosting policy:

There are a limited number of postdoctoral fellows (only one in the last evaluation period), thereby diminishing the potential for recruiting young scientists through CNRS and Inserm competitions. The self-assessment report highlights the upcoming retirement of several principal investigators during the next term.

3) Attractiveness for the quality of its major equipment and technological skills:

The strategy to replace certain obsolete equipment should be better defined. The replacement of these devices is a crucial aspect for the unit's visibility and attractiveness.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

The scientific productivity of the unit has further developed in the last reporting period and has reached very good levels, with contributions which are of international relevance in the field.

1/ The scientific production of the unit meets quality criteria.

2/ The unit's scientific production is proportionate to its research potential and properly shared out between its personnel.

3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science. It complies with the directives applicable in this field.

Strengths and possibilities linked to the context for the three references above

Among the reported 335 publications, 134 publications have B3OA members as last author.

Twenty-four publications are rated as exceptional (e.g.' Interfacial fluid transport is a key to hydrogel bioadhesion', Proc Natl Acad Sci U.S.A. 2019; and 'The tumours and the three bumps', Lancet Oncol. 2022).

Sixty-three manuscripts are rated as excellent (such as 'Type 2 diabetes impairs angiogenesis and osteogenesis in calvarial defects: MicroCT study in ZDF rats', Bone. 2018; and 'Custom-made macroporous bioceramic implants based on triply periodic minimal surfaces for bone defects in load-bearing sites, Acta Biomater. 2020 –

This was determined by INSIS CNRS considering a variety of scientific disciplines, research types (e.g. basic and frontier research vs. applied research), as well as research career stages (e.g. early career researchers vs. senior researchers). Members of B3OA have published in a broad range of journals in the scientific and clinical fields pertinent to the unit main topics (e.g. Bone, J Cell Mol Med, Stem Cells, Acta Biomater, Materials, Int Orthopedics). The majority of the permanent research staff as well as the technical staff such as engineers and technicians are co-authors of several manuscripts. Hundred twenty-nine publications, almost a third of the total scientific production, are co-authored with international collaborators. An average of 13.4 manuscripts per full-time permanent staff has been published during the 2017-22 period, or>3 manuscripts per year per full-time equivalent. This seems to be an excellent production, proportionate to the unit size and shared between its researchers. Hundred thirty-nine manuscripts have been published in journals focusing on topics of experimental research, while 196 manuscripts have been published in clinical research focused journals. More precisely, 175 manuscripts focused on OA diseases, 106 manuscripts on fundamental aspects of bone repair and 86 publications on translational aspects of bone repair. A balanced unit output in terms of clinical, translation and basic research has been achieved.
The B3OA unit has implemented transparent processes (e.g. process for dealing with integrity breach, use of plagiarism software) concerning scientific integrity and ethics. An internal plagiarism prevention officer has been appointed, responsible for providing training to unit's members on the topics.
Almost 50% of the publications of the B3OA unit have an open access status (circa 20% Gold, 3% Gold-Hybrid, 12% Bronze and 12% Green).

Weaknesses and risks linked to the context for the three references above

Clinical and scientific publications typically do not share the same unit authors, which suggests a certain impermeability in the research domains (Clinical research for OA diseases, fundamental aspects of bone repair and translational aspect for bone repair). There could be a risk that the scientific and clinical interests of the respective active researchers may diverge and reduce the Unit efficiency.

A large part of the US shared manuscripts are based on a single collaboration. There is a risk for a drop of publication numbers with international co-authors.

The publication in open access journals is still rather limited, namely 50% of the total scientific production for the 2017-22 Period.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

The unit has performed very well in the quality of its interactions with scientific society in the broad sense of the term, as well as with the broader audience.

1/ The unit stands out for the quality and the amount of its interactions with the non-academic world.

2/ The unit develops products for the cultural, economic and social world.

3/ The unit shares its knowledge with the general public and takes part in debates in society.

Strengths and possibilities linked to the context for the three references above

B3OA has interactions with mainly 6 companies (i.e. Spineart, ICERAM, Movmedix, Septdodont, GLEAMER, C/C Contact), and has also been able to produce patented innovation (2 patents deposited + 1 pending).

B3OA engages in translational research associated with two ongoing clinical trials and the development of new tools for clinical applications. Clinicians, predominantly surgeons, conduct research directly connected to their daily practices.

The laboratory is crucial for surgeons, particularly orthopedic surgeons, as they pursue research at the master's and PhD levels, further contributing to research aligned with their clinical practices in an academic setting.
Several projects are of high social and public health impact, particularly Theme 2 – Project 4 'Clinical innovations in orthopedic surgery practice (Task 1 and task 4 about TKR procedure-related pain and physical activity and rehabilitation). The unit has also developed a unique cell line designed to assess the biological activity of BMP, which has been distributed freely to more than fifteen laboratories internationally to improve actively research quality performed in the field. The noteworthy outcomes of these research initiatives are disseminated to the broader community via diverse channels, including a dedicated website and events such as a video realised by Mathieu Manassero in 2019, appearances on high-audience TV programs, and reports in mainstream newspapers.

Weaknesses and risks linked to the context for the three references above

Only one CIFRE grants for doctoral students have been obtained, despite the interaction with companies, nor the financial impact of such industrial collaborations.
There is, for example, no mention about potential LabCom construction (partnership between public institutions and private companies). While there is a reasonable exchange of knowledge and discussion with the general public, this engagement appears to be driven primarily by the researchers of the unit rather than by clinicians who seem to have a limited involvement in patient societies.

ANALYSIS OF THE UNIT'S TRAJECTORY

The Unit has reorganised the clustering of the projects and grouped them into two (instead of three) themes, namely (i) Bioimaging and bioengineering for OA repair in compromised contexts and (ii) Biomaterials and medical devices for repair of osteoarticular tissues. The new structure is organic and sound, although it should more precisely define priorities and possibly introduce more focus in the broad range of activities planned. The reorganisation of the themes may require reshaping after proof-of-concept initiatives in the fields of intervertebral disc degeneration and delivery of mRNA.
Importantly, it will be necessary to clarify as soon as possible the future of the Unit, in view of the envisioned possibility of merging with another one from the Science Faculty.

RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

The Unit is recommended to further leverage on the distinct opportunity to embed clinicians into scientific and research projects. This may require defining structured programs for protected time for clinicians and organising internal events where clinicians and scientists have opportunity to exchange views and shape projects.
The Unit should better show how the HRS4R (human resource strategy for researchers) coming from the CNRS is considered to strengthen and support the attractiveness and organisation.

Recommendations regarding the Evaluation Area 2: Attractiveness

The Unit is recommended to further develop those initiatives that can lead to international visibility and interactions, as a bottom-up strategy to attract postdocs to the unit and to join forces with other European groups in participating to EU calls. A strategy for recruiting new scientists is therefore crucial and would need to be better defined and strengthened. A better strategy in terms of partnership with companies should be better defined for the future. A stronger presence on social channels should be considered as an important asset for the next period.

Recommendations regarding Evaluation Area 3: Scientific Production

The Unit is recommended to strengthen the research areas which are most advanced and visible and to strategically de-prioritise certain projects, in view of gaining quality, scientific depth and translational capacity on the central scientific programs. Scientific recognition through awards and prizes should be given higher priority to enhance international visibility and cooperation.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

The Unit is recommended to increase the level of engagement with the general public and to establish contact with patients' associations, both national and international.
The Unit's contribution to the dissemination and impact of its research activities could be enhanced by defining and implementing a clear strategy.
A better strategy in terms of partnership with companies should be better defined for the future.
Two patents are mentioned during the last term about skin collagen as biomarker for bone matrix quality. Their development or licensing perspective with industrial partners should be discussed.

CONDUCT OF THE INTERVIEWS

Date

Start: 14 novembre 2023 à 8 h 30

End: 14 novembre 2023 à 18 h 30

Interview conducted: online

INTERVIEW SCHEDULE

8:30 a.m.-8:45 a.m. Presentation of the committee
8:45 a.m.-9:05 a.m. Highlights of the Unit by the Director (**H. Petite**) – *10′ presentation, 10′ questions*
9:05 a.m.-9:17 a.m. A paradigm shift to solve the roadblock of MSC survival post-implantation (**E. Potier**) – *7′ presentation, 5′ project-specific questions*
9:17 a.m.-9:29 a.m. Participation of the B3OA in the development of a carrier-free DBM putty for bone repair (**F. Anagnostou**) – *7′ presentation, 5′ project-specific questions*
9:29 a.m.-9:41 a.m. Enhanced bone formation induced by BMP2 delivered from 3D scaffold coatings made of extracellular matrix (ECM) components (**D. Logeart-Avramoglou**) – *7′ presentation, 5′ project-specific questions*
9:41 a.m.-9:53 a.m. Clinical assessment of bone toughness and ductility based on skin surface pattern (**J.C Auregan**) – *7′ presentation, 5′ project-specific questions*
9:53 a.m.-10:05 a.m. Biomechanical and biological optimisation of synthetic ligaments for anterior cruciate ligament (ACL) replacement and regeneration (**V. Viateau**) – *7′ presentation, 5′ project-specific questions*

10:10 a.m.-10:30 a.m. Coffee break

10:30 a.m.-11 a.m. Overview of the trajectory by the Director (**H. Petite**)
11 a.m.-11:30 a.m. Discussion with the committee

11:30 a.m.-12:30 p.m. Closed-door meeting of the committee

12:30 p.m.-1:30 p.m. Lunch break

1:30 p.m.-1:55 p.m. Meeting with technicians and administrative staff
1:55 p.m.-2:20 p.m. Meeting with PhDs and postdocs
2:20 p.m.-2:45 p.m. Meeting with researchers non theme leaders
2:45 p.m.-3:10 p.m. Meeting with theme leaders
3:10 p.m.-3:30 p.m. Meeting with the representatives of the local institutions

3:30 p.m.-4 p.m.Coffee break

4 p.m.-4:30 p.m.Closed-door meeting of the committee

4:30 p.m.-5 p.m. Meeting with the Director

5 p.m.-6:30 p.m.Closed-door meeting of the committee

PARTICULAR POINT TO BE MENTIONED

No particular point to be mentioned

GENERAL OBSERVATIONS OF THE SUPERVISORS

Université Paris Cité

Le Président

Paris, le 6 mars 2024

HCERES
2 rue Albert Einstein
75013 Paris

Objet : Rapport d'évaluation de l'unité **DER-PUR250024158 – B3OA – Biologie, bioingénierie et bioimagerie ostéo-articulaires.**

Madame, Monsieur,

L'université Paris Cité (UPCité) a pris connaissance du rapport d'évaluation de l'Unité de Recherche **B3OA – Biologie, bioingénierie et bioimagerie ostéo-articulaires.**

Ce rapport a été lu avec attention par la direction de l'unité, le vice-doyen Recherche et le doyen de la Faculté de Santé d'UPCité qui n'ont pas signalé d'erreurs factuelles, par la vice-présidente Recherche d'UPCité et par moi-même.

Le doyen de la Faculté de Santé et moi même souhaitons souligner que l'unité B3OA est une unité multitutelles (CNRS, INSERM, UPC, École Nationale Vétérinaire Alfort - EnvA) dans le domaine de l'ostéoarticulaire. Cette unité développe des approches à la fois diagnostique, chirurgicale et de réadaptation des patients. Elle a la particularité de développer une recherche très translationnelle allant du fondamental à l'appliqué et passant par des modèles animaux, et inclut à ce titre notamment des vétérinaires dans l'unité. Comme relevé dans le rapport, la co-labellisation de cette unité par l'EnvA est une force à la fois pour l'unité mais également pour la Faculté de Santé et UPCité ; il s'agit de la seule unité d'UPCité co-labellisée par l'EnvA.

Nous remercions le comité pour la qualité de ce travail d'évaluation.

Je vous prie d'agréer, Madame, Monsieur, l'expression de ma considération distinguée.

Édouard Kaminski

Présidence

Référence
Pr/DGDRIVE/2023

Affaire suivie par
Christine Debydeal - DGDRIVE

Adresse
85 boulevard St-Germain
75006 - Paris

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Christine Debydeal

Objet: TR: Hcéres - demande de retour des observations des tutelles sur le rapport d'évaluation - DER-PUR250024158 - B3OA - Biologie, bioingénierie et bioimagerie ostéo-articulaires

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De : TISSIER Renaud <renaud.tissier@vet-alfort.fr>
Envoyé : lundi 12 février 2024 17:04
À : Marine MADANI <marine.madani@u-paris.fr>; CNRS Correspondant <hceres.eval-unites@cnrs.fr>; Correspondant Ecole nationale vétérinaire d'Alfort (EnvA) <direction@vet-alfort.fr>; Correspondant INSERM <eval-structures.desp@inserm.fr>; Correspondant 2 INSERM <samia.deghmoun@inserm.fr>
Objet : Re: Hcéres - demande de retour des observations des tutelles sur le rapport d'évaluation - DER-PUR250024158 - B3OA - Biologie, bioingénierie et bioimagerie ostéo-articulaires

Bonjour,

Merci beaucoup. Pas de commentaire particulier pour l'EnvA. Félicitations au B3OA.

Bien à vous,

Renaud Tissier

Christine Debydeal

Objet: TR: Hcéres - demande de retour des observations des tutelles sur le rapport d'évaluation - DER-PUR250024158 - B3OA - Biologie, bioingénierie et bioimagerie ostéo-articulaires

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De : CNRS-Hcéres Evaluation unités <hceres.eval-unites@cnrs.fr>
Envoyé : mardi 13 février 2024 13:06
À : Marine MADANI <marine.madani@u-paris.fr>; Correspondant Ecole nationale vétérinaire d'Alfort (EnvA) <direction@vet-alfort.fr>; Correspondant INSERM <eval-structures.desp@inserm.fr>; Correspondant 2 INSERM <samia.deghmoun@inserm.fr>
Objet : RE: Hcéres - demande de retour des observations des tutelles sur le rapport d'évaluation - DER-PUR250024158 - B3OA - Biologie, bioingénierie et bioimagerie ostéo-articulaires

Bonjour Madame,
Je vous prie de bien vouloir noter que le CNRS n'émettra pas de réponse institutionnelle de type « observations de portée générale ».
Je reste à votre disposition pour tout complément d'information.
Bien à vous,

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Frédéric FRANCOIS-ENDELMONT
CNRS – DAPP
Direction d'appui aux partenariats publics
3 rue Michel-Ange - 75794 Paris Cedex 16
Secrétariat : 01.44.96.41.10
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