Research degrees

You may study for an MPhil or PhD degree in a stimulating and well-equipped research environment. Our research teams bring together both clinical and non-clinical researchers in partnerships that provide the opportunity to link together a range of multidisciplinary expertise. This approach allows a particularly strong and supportive environment in which you can undertake your training and benefit from interaction with leading researchers.

You undertake formal training to develop the skills required within your research. While at the school you have at least one supervisor with whom you have regular contact, and who provides guidance in your learning and research. During this time, you are encouraged to present work in seminars and at conferences, both to develop your presentation skills and to make contact with other researchers.

The three main areas of **research (/schools/dentistry/research/index.aspx)** **in our School (/schools/dentistry/research/index.aspx)** are: Biomaterials, Primary Dental Care and Tissue Injury and Repair. A number of opportunities are currently available at the School of Dentistry for self-funded PhD studentships in the areas of:

Open all sections

Molecular Biology of Oral Disease...

An understanding of the molecular basis of oral diseases has the potential to underpin the development of **new diagnostic methodologies** and identify **novel treatment modalities**.

Within the **Molecular Biology facility** at the School of Dentistry we are applying molecular and cellular techniques to try and understand the pathogenesis of a range of oral diseases including dental caries, oral lichen planus and oral cancer. In addition, we also collaborate with the Biomaterials Unit within the School of Dentistry to look at the biocompatibility aspects of dental materials and the tissue engineering of oral mucosa and bone.

Specific areas of interest of our group include:

- Modulation of pulpal inflammation and tertiary dentinogenesis
- Identification of novel markers of odontoblasts
- Calcium hydroxide based dental materials in tooth repair
- Adrenomedullin in tooth development and repair
- Molecular basis of oral lichen planus

How to apply

At present, we would only consider applications from **self-funded** prospective students with:

- a good biomedical degree, with interests in any of the areas outlined above,
- good command of the English language (written and spoken) as outlined in the **postgraduate prospectus (http://www.postgraduate.bham.ac.uk/)** ,
- a source of funding to cover **tuition fees** and **bench fees** (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility to join our group as a PhD student, please contact **Dr Paul Cooper (mailto:p.r.cooper.1@bham.ac.uk)** for an informal discussion.

Relevant references:

- The effect of calcium hydroxide on solubilisation of bio-active dentine matrix components. Graham L, Cooper PR, Cassidy N, Nor JE, Sloan AJ, Smith AJ. Biomaterials. 2006 **27**(14):2865-73. Epub 2006 Jan 19.
- Gene expression profiling of pulpal tissue reveals the molecular complexity of dental caries. McLachlan JL, Smith AJ, Bujalska IJ, Cooper PR. Biochim Biophys Acta. 2005 **1741**(3):271-81. Epub Apr 8.
- S100 and cytokine expression in caries. McLachlan JL, Sloan AJ, Smith AJ, Landini G, Cooper PR. Infect Immun. 2004 **72**(7):4102-8.
- Piezo-power microdissection of mature human dental tissue. McLachlan JL, Smith AJ, Cooper PR. Arch Oral Biol. 2003 **48**(10):731-6.
- Gene expression analysis in cells of the dentine-pulp complex in healthy and carious teeth. McLachlan JL, Smith AJ, Sloan AJ, Cooper PR. Arch Oral Biol. 2003 **48**(4):273-83.
- Cloning and expression analysis of a novel G-protein-coupled receptor selectively expressed on granulocytes. Yousefi S, Cooper PR, Potter SL, Mueck B, Jarai G. J Leukoc Biol. 2001 **69**(6):1045-52.
- Identification of genes induced by inflammatory cytokines in airway epithelium. Cooper P, Potter S, Mueck B, Yousefi S, Jarai G. Am J Physiol Lung Cell Mol Physiol. 2001 **280**(5):L841-52.

Quantitative Pathology...

Quantitative Pathology investigates problems in pathology using innovative, analytical methods to collect **reliable**, **quantifiable** and **reproducible** markers of disease. This is necessary to provide **accurate**, **evidence-based diagnostic decisions** and accurate **prognostic** parameters.
Many of the tools pioneered by our team are based on **digital image processing / analysis** with an ultimate goal of developing **intelligent diagnostic instrumentation**.

The areas of interest of our group include:

- **Tissue/cell segmentation** in histopathological imagery
- **Patterns of invasion** of oral cancer modelled using **fractal geometry**
- **Nuclear and cell shape** characterisation in oral cancer/precancer
- Morphological aspects of **Lichen Planus**
- Morphological aspect of **ageing of the oral mucosa**
- Systematisation of **epithelial architecture** using **mathematical morphology** and **graph theory**
- Analysis and computer simulation of **chimaeric mosaic patterns**
- Models of **cystic growth**

- Models of **parenchyma formation** during **organogenesis**

How to apply

At present, we would only consider applications from **self-funded** prospective students with:

- a good biomedical or engineering/computing degree, with interests in any of the areas outlined above,
- good command of the English language (written and spoken) as outlined in the **postgraduate prospectus (http://www.postgraduate.bham.ac.uk/)** ,
- competent with computers and data handling (ideally with Java programming skills),
- a source of funding to cover **tuition fees** and **bench fees** (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility of joining our group as a PhD student, please contact **Prof. G. Landini (mailto:g.landini@bham.ac.uk)** for an informal discussion.

Relevant references:

- Landini G. Iannaccone P. Modelling of patterns in chimaeric liver and adrenal cortex: algorithmic organogenesis? ***FASEB Journal*** 14, 823-827, 2000.
- Landini G, Hirayama Y, Li TJ, Kitano M. Increased fractal complexity of the epithelial-connective tissue interface in the tongue of 4NQO-treated rats. ***Pathology Research and Practice*** 196, 251-258, 2000.
- Iannaccone P, Morley S, Skimina T, Mullins J, Landini G. Cord-like mosaic patches in the adrenal cortex are fractal: implications for growth and development. ***FASEB Journal*** 17: 41-43, 2003.
- Landini G, Othman IE. Estimation of tissue layer level by sequential morphological reconstruction. ***Journal of Microscopy***, 209(2): 118-125, 2003.
- Abu Eid R, Landini G. Quantification of the global and local complexity of the epithelial-connective tissue interface of normal, dysplastic and neoplastic oral mucosae using digital imaging. ***Pathology Research and Practice*** 199(7):475-482, 2003.
- Landini G, Othman IE. Architectural analysis of oral cancer, dysplastic and normal epithelia. ***Cytometry A***, 61A: 45-55, 2004.
- Ward JP, Magar V, Franks SJ, Landini G. A model on the dynamics of odontogenic cyst growth. ***Analytical and Quantitative Cytology and Histology***, 26 (1): 39-46, 2004.
- Abu Eid R, Landini G. The Morphometry of Pseudoepitheliomatous Hyperplasia: An Objective Comparison to Normal and Dysplastic Oral Mucosae. ***Analytical and Quantitative Cytology and Histology*** 27(4): 232-40, 2005
- Abu Eid R, Landini G. Morphometrical differences between pseudo-epitheliomatous hyperplasia in granular cell tumours and squamous cell carcinomas. ***Histopathology*** 48: 407-416, 2006.
- Landini G. Quantitative analysis of the epithelial lining architecture in odontogenic cysts. ***Head and Face Medicine*** 2 (Feb):4, 2006.

Dental Tissue Regeneration...

Advances in our understanding of cell behaviour have provided exciting opportunities to develop novel, biologically-based therapies for tissue regeneration in the tooth. While reconstruction of the entire tooth is a long term goal for tissue engineering, there is immense scope for tissue regeneration in the tooth to restore the effects of injury and disease. Within the Pulp Biology research team at the School of Dentistry, we are using a variety of molecular and cellular techniques to understand how the tooth responds to injury and the nature of the regenerative processes in the dentine-pulp complex. This research encompasses collaborations with a number of researchers within the School and around the globe.
Specific areas of interest of our group include:

- cellular responses of the dentine-pulp complex to injury
- the control and modulation of cell matrix secretion in dentine-pulp
- post-natal dental pulp stem cells and their exploitation for tissue regeneration
- cellular signalling processes for dental tissue regeneration

How to apply

At present, we could only consider applications from **self-funded** prospective students with:

- a good biomedical degree, with interests in any of the areas outlined above,
- good command of the English language as outlined in the **postgraduate prospectus (http://www.postgraduate.bham.ac.uk/)** ,
- a source of funding to cover **tuition fees** and **bench fees** (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility to join our group as a PhD student, please contact **Prof. Tony Smith (mailto:a.j.smith@bham.ac.uk)** for an informal discussion.

Biomaterials...

Biomaterials are an extraordinarily diverse group of materials used for replacing or augmenting damaged, diseased or missing tissues. As such biomaterials range from artificial joint prostheses through to contact lenses and artificial blood vessels or heart valves. Biomaterials research is necessarily multidisciplinary and projects can be tailored to meet many interests within materials science based or more biologically orientated subject areas, indeed we collaborate with many groups throughout the University. The aim of all projects is to develop a scientific basis for improvements in healthcare. Currently the Biomaterials Unit has major interests in the development of improved dental restorative materials, generation of better methods and materials for replacing and cementing bone, establishing methods to minimise bacterial infection of biomaterials and developing techniques for generating oral mucosal replacements and understanding oral mucosal diseases. Specific areas of interest of our group include:

- Bacterial biosynthesis of high strength nanoparticulate hydroxyapatite
- Prevention of biomaterials-associated infections
- Tissue engineering scaffolds
- Osteoblast responses to different materials

- Improving material properties and setting reactions of dental composite resins
- Replacing oral mucosa

How to apply

At present, we could only consider applications from **self-funded** prospective students with:

- a good biomedical degree, with interests in any of the areas outlined above,
- good command of the English language as outlined in the **postgraduate prospectus (http://www.postgraduate.bham.ac.uk/)** ,
- a source of funding to cover **tuition fees** and **bench fees** (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility to join our group as a PhD student, please contact the relevant member of staff in the description of projects for an informal discussion.

Bacterial biosynthesis of high strength nanoparticulate hydroxyapatite
PhD Project: Novel nanomaterials for biomedical applications.

Serratia N14 is a non-pathogenic Gram-negative bacterium that grows as a biofilm on titanium, stainless steel, and polymeric support materials. A bacterial acid phosphatase enzyme associated with the cell-wall catalyses the biosynthesis of nanophase crystalline hydroxyapatite (HA) or beta-tricalcium phosphate (beta-TCP), which accumulate outside the cells. Crystal size and calcium phosphate phase (HA or beta-TCP) is dependent on pH and the presence or absence of specific additional ions. Using this system, crystals can be manufactured in the form of coatings on metal and polymeric substrata, powders and porous scaffolds for potential bone replacement. This is a novel alternative method of manufacture of calcium phosphates for potential biomedical applications and for coating materials with complex architectures.

The PhD student would investigate the effect of modification of the biofilm and calcification processes and the incorporation of additional ions into the crystal structures. The project will be interdisciplinary, involving microbiology (growth of biofilm) and materials science (calcium phosphate physical and chemical analysis; mechanical testing).

Supervisor: Dr R.L. Sammons (mailto:r.l.sammons@bham.ac.uk) .

References:

- Thackray AC et al. (2004) Bacterial biosynthesis of a calcium phosphate bone-substitute material. Journal of Materials. Science Materials in Medicine, 15, 403-406.
- Macaskie LE et al (2005) Novel non line of-sight method for coating hydroxyapatite onto surfaces of support materials by biomineralization. Journal Biotechnology 118, 187-200.
- Ledo, HM et al (2008) Microstructure and composition of biosynthetically synthesised hydroxyapatite Journal of Material Science - Materials in Medicine, 19, 3419-3427.
- Yong P et al. (2004) Synthesis of nanophase hydroxyapatite by a Serratia sp from waste-water containing inorganic phosphate. Biotechnology Letters 26, 1723-173.0

Tissue engineering scaffolds.
PhD Project. Hydrogels for tissue engineering scaffolds containing cells.

The aim of the project is to investigate the potential of various polysaccharide hydrogels for use as tissue engineering scaffold materials to enable cells to be cultured both on and within the material. The project will focus upon ways in which the mechanical properties of such materials can be optimised for a variety of applications without damaging the internalised cell population.

Supervisor: Dr R.M.Shelton (mailto:r.m.shelton@bham.ac.uk) .

References:

- Evaluation of sodium alginate for bone marrow cell tissue engineering. L Wang, RM Shelton, P.R. Cooper, M Lawson, JT Triffitt, JE Barralet. Biomaterials, 24, (20): 3475-3481, 2003.
- Adhesion and growth of bone marrow stromal cells on modified alginate hydrogels. MA Lawson, JE Barralet, L Wang, RM Shelton, JT Triffitt. Tissue Engineering 10 (9-10), 1480-1491, 2004.
- Comparison of bone marrow cell growth on 2D and 3D alginate hydrogels. JE Barralet, L Wang, MA Lawson, JT Triffitt, PR Cooper, RM Shelton Journal of Materials Science: Materials in Medicine 16, (6), 515-519, 2005.

Prevention of biomaterials-associated infections

The aim of this project is to develop and evaluate the effectiveness of antimicrobial calcium phosphate bone graft materials, bone cements and coatings for metallic and polymer surfaces that are intended to inhibit bacterial attachment and proliferation either in the body or in a clinical environment such as a hospital, to reduce the risk of cross-infection.

Supervisor: Dr R.L. Sammons (mailto:r.l.sammons@bham.ac.uk) .

Improving material properties and setting reactions of dental composite resins

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Replacing oral mucosa
PhD Project. Investigation into the potential of using different delivery systems of cultured oral keratinocytes as a possible treatment for mucosal defects.

The overall aim of the project is to investigate the possibility of being able to remove a small biopsy of a patients oral mucosa from a suitable site, expand the numbers of keratinocytes in culture, before seeding these cells onto a suitable delivery system and reimplanting into the patient over their mucosal defect. The project will involve establishing cultures of human oral keratinocytes from different sites within the mouth, growing these cells on feeder layers of fibroblasts before digestion of the cells and reseeding onto different delivery substrates. To determine the feasibility of such an approach, keratinocyte expression of cytokeratins will be assessed both before and after seeding onto the delivery substrates using immunohistochemistry and RT-PCR, to examine whether the cells' phenotype has been maintained from the particular isolation site. These delivery substrates, seeded with keratinocytes will be maintained as so-called organotypic cultures for defined periods and cell viability and proliferation will be monitored and optimised. The project therefore will combine a wide range of cell culture and molecular biological approaches in addition to a sound general training in research.

Supervisors: **Dr R.M.Shelton (mailto:r.m.shelton@bham.ac.uk)** and **Dr Paul Cooper (mailto:p.r.cooper.1@bham.ac.uk)** .
Reference:

- In vitro transfer of keratinocytes: Comparison of transfer fibrin membrane and delivery by aerosol spray. CO Duncan, RM Shelton, H Navsaria, DS Balderson, RPG Papini, JE Barralet. Journal of Biomedical Materials Science Part B Applied Biomaterials 73B, (2): 221-228, 2005

PhD Project. Establishment and analysis of an oral keratinocyte organotypic model.

Project Aims: To develop an organotypic model of oral mucosa, comparing the suitability of particular donor sites within the oral cavity. To quantitatively evaluate the morphological similarities in vitro and in vivo. To identify the effects of known carcinogens (including tobacco extract and 4NQO) on the morphology and gene expression of oral mucosa in vitro. Initially keratinocytes isolated from different sites of adult and neonate rat oral mucosa will be established in culture grown on a feeder layer of fibroblasts before transferring the keratinocytes to different examples of organotypic cultures and examining the influence of passage number, the site from which samples were isolated and the type of culture on the gene expression and histological behaviour of the keratinocytes. Having established which cultures best represent the in vivo tissues, further cultures will be established and exposed to different conditions to include cigarette smoke extract, a known carcinogen (4NQO), hydrogen peroxide to identify how these conditions influence the behaviour of the keratinocytes using immunohistochemistry, RT-PCR and image analysis of histological sections.

Supervisors: **Dr Paul Cooper (mailto:p.r.cooper.1@bham.ac.uk)** , **Dr R.M.Shelton (mailto:r.m.shelton@bham.ac.uk)** and **Prof. G. Landini (mailto:g.landini@bham.ac.uk)**

Osteoblast responses to different materials
PhD Project. Modulation of osteoblast responses to differently formulated bone cements

The aim of the project is to investigate how different formulations of bone cement affect the behaviour and gene expression of both osteoblasts and bone marrow cells. The project will focus upon ways in which the osteoblast phenotype may be promoted and whether inclusion of different arrays of proteins influence the response.

References:

- Primary bone-derived cell colonization of unconditioned and pre-conditioned Bioglass 45S5 surfaces in vitro. Mortin LA, Shelton RM. Journal of Materials Science: Materials in Medicine, 14 (4): 297-305, 2003.
- Evaluation of sodium alginate for bone marrow cell tissue engineering. L Wang, RM Shelton, P.R. Cooper, M Lawson, JT Triffitt, JE Barralet. Biomaterials, 24, (20): 3475-3481, 2003.
- Homogeneous octacalcium phosphate precipitation: Effect of temperature and pH. Y Liu, RM Shelton, J.E. Barralet. Key Engineering Materials, 254-2, 79-82, 2004.
- Adhesion and growth of bone marrow stromal cells on modified alginate hydrogels. MA Lawson, JE Barralet, L Wang, RM Shelton, JT Triffitt. Tissue Engineering 10 (9-10), 1480-1491, 2004.
- Comparison of bone marrow cell growth on 2D and 3D alginate hydrogels. JE Barralet, L Wang, MA Lawson, JT Triffitt, PR Cooper, RM Shelton Journal of Materials Science: Materials in Medicine 16, (6), 515-519, 2005.
- Bone marrow cell gene expression and tissue construct assembly using octacalcium phosphate microscaffolds. R.M. Shelton, Y. Liu, P.R. Cooper, U. Gbureck, M.J. German and J.E. Barralet. Biomaterials, 27, (14), 2874-2881, 2006.

Supervisor: **Dr R.M.Shelton (mailto:r.m.shelton@bham.ac.uk)** and**Dr M. P. Hofmann (mailto:m.p.hofmann@bham.ac.uk)**

Ultrasound in Dentistry...

There is an active research group looking at the use of ultrasound in dentistry. We have specialist technical knowledge using scanning laser vibrometry to assess the oscillation characteristics of vibrating objects. However, our work has also investigated the vibrations of endosonic files, retrograde tips and powered toothbrushes. Potential projects include:

- **Ultrasonic scalers**. The oscillatory characteristics of dental ultrasonic instruments both ultrasonic and sonic will be characterised. Work would progress to determine how their oscillation effects the hard dental tissues.
- **Endosonics**. The oscillation of the current range of endosonics instrumentation will be measured. Work would then progress to evaluate how cavitation and streaming enhances the activity of the irrigating solution. There is renewed interest in this form of endodontic instrumentation and how it may provide success in root canal treatment
- **Powered toothbrushes**. Such health care devices are a popular product. Our research looks at their movement and how the designs can be improved. We will evaluate this movement and its effectiveness on appropriate tooth models.

How to apply

At present, we could only consider applications from **self-funded** prospective students with:

- a good biomedical degree, with interests in any of the areas outlined above,

- good command of the English (written and spoken) language as outlined in the **postgraduate prospectus (http://www.postgraduate.bham.ac.uk/)** , prospectus,
- a source of funding to cover **tuition fees** and **bench fees** (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility to join our group as a PhD student, please contact **Prof. Damien Walmsley (mailto:a.d.walmsley@bham.ac.uk)** for an informal discussion.

References:

- Lea SC, Walmsley AD. Technology Transfer in Dentistry: Technology, ultrasonics and dentistry. Dental Update 2002; 29: 390-395.
- Lea SC, Landini G, Walmsley AD. Ultrasonic scaler tip performances under various load conditions. Journal of Clinical Periodontology 30: 876-81, 2003.
- Lea, S.C., Walmsley, A.D. Lumley, P.J. and Landini, G. A New Insight into the Oscillation Characteristics of Endosonic Files used in Dentistry. Physics in Medicine and Biology, 2004; 49: 2095-2102.
- Lea, S.C., Landini, G. and Walmsley AD. A Novel Method for the Evaluation of Powered Toothbrush Oscillation Characteristics. American Journal of Dentistry, 2004; 17: 307-309.
- Lea SC, Price GJ, Walmsley AD. A Study to Determine Whether Cavitation Occurs around Dental Ultrasonic Scaling Instruments. Ultrasonics and Sonochemistry 2005; 12: 233-236.

Periodontal Research...

Periodontal Research A major focus of the periodontal research group (PRG) lies in unravelling some of the complex stress response pathways in periodontitis, at the molecular, cellular and clinical level. Broad expertise has allowed the study of interactions between oral bacteria, epithelial cells and those of the inflammatory-immune system. In addition the group retains a strong interest an expertise in the elucidation of novel biomarkers of periodontal disease progression and early diagnosis and their implementation through near-patient-testing.

Current Projects :

- The cellular and molecular basis of peripheral blood neutrophil hyper-responsivity in periodontitis patients.
- Study of extracellular neutrophil traps (NETS) & bacterial DNAses in periodontal pathology.
- The role of the gingival epithelium in establishing inflammatory processes.
- The role of redox biology in controlling gene expression & inflammatory sequelae.
- The development of novel approaches to modulating gene expression via micro-nutritional approaches.
- Effects of cigarette smoke extract upon neutrophil and epithelial cell behaviour.
- The role of oxidative stress as a mechanistic link between periodontitis & type 2 diabetes.

How to apply

At present, we would only consider applications from **self-funded** prospective students with:

- a 1st. class biomedical degree (or possibly a 2:1)
- a source of funding to cover **tuition fees** and **bench fees**. (note that tuition fees are different for Home and EU students than for International students).

If you would like to discuss the possibility of joining our group as a PhD student, please contact **Prof ILC Chapple (mailto:I.L.C.CHAPPLE@bham.ac.uk)** , **Dr JB Matthews (mailto:j.b.matthews@bham.ac.uk)** , or **Dr Paul Cooper (mailto:p.r.cooper.1@bham.ac.uk)** for an informal discussion.

Relevant references:

- Wright HJ, Matthews JB, Chapple ILC, Ling-Mountford N, Cooper PR. Periodontitis Associates with a Type 1 IFN Signature in Peripheral Blood Neutrophils, Journal of Immunology 2008, 181, 8: 5775-84.
- Dias HKI, Lambert PA, Marshall L, Chapple ILC, Matthews JB, Griffiths HR. Gingipains from Porphyromonas gingivalis increase chemotactic properties of IL-8-77. Infection and Immunity 2007, DOI.1128/IAI.00618-07.
- Chapple ILC, Milward MR, Dietrich T. The prevalence of inflammatory periodontitis is negatively associated with serum antioxidant concentrations. Journal of Nutrition 2007;137:657-664.
- Matthews JB, Wright HJ, Roberts A, Cooper PR, Chapple IL. Hyperactivity and reactivity of peripheral blood neutrophils in chronic periodontitis. Clin Exp Immunol. 2007;147:255-64.
- Chapple ILC, Matthews JB. The role of reactive oxygen and antioxidant species in periodontal tissue destruction. Periodontol 2000 2007; 43: 160-232.
- Matthews JB, Wright HJ, Roberts A, Ling-Mountford N, Cooper PR, Chapple ILC. Neutrophil hyper-responsiveness in periodontitis. J Dent Res 2007;86:718-722.
- Milward MR, Chapple ILC, Wright HJ, Millard J, Matthews JB, Cooper PR. Differential activation of NF-kB and gene expression in oral epithelial cells by periodontal pathogens. Clin Exp Immunol 2007; 148:307-324.
- Maxwell SRJ, Dietrich T, Chapple ILC. The prediction of total antioxidant activity from the concentration of individual serum antioxidants. Clinica Chimica Acta, 2006:372; 188-194.
- Barnfather KDP, Cope GF, Chapple ILC. Randomised controlled trial investigating the impact of incorporating a 10-minute point of care test for salivary nicotine metabolites into a general practice-based smoking cessation programme. British Medical Journal, 2005, doi:10.1136/bmj.38621.463900.7C.
- Roberts A, Matthews J B, Socransky S S, Freestone P, Williams P H, Chapple I L C. Stress and the periodontal diseases: growth responses of periodontal bacteria to Escherichia coli stress-associated autoinducer and exogenous Fe. Oral Microbiology & Immunology, 2005: 20, 147-153.
- Murdoch F E, Sammons R, Chapple I L C. Isolation and categorisation of subgingival staphylococci from periodontitis patients and controls: implications for the pathogenesis of prosthetic valve endocarditis. Oral Diseases, 2004: 10, 155-162.
- Chapple I L C, Brock G, Eftimiadi C, Matthews J B. Glutathione in gingival crevicular fluid and its relation to local antioxidant capacity in periodontal health and disease. J Molecular Pathology, 2002: 78, 55, 367-373.