

## **A Dental Technology Teaching Suite for the 21<sup>st</sup> Century**

### **Dental School**

Dental students have been educated in Glasgow since 1879. The School of Dental Surgery and Dental Hospital of Glasgow was established following the Dentist's Act of 1878 and the Faculty of Physicians and Surgeons was given authority to institute examinations and award diplomas. In 1947 the University took control of the Dental School and has been awarding the BDS degree since 1948.

In the 135 years since its establishment, the Dental School has evolved progressively in response to both professional and educational advances. A radically revised BDS curriculum was rolled out between 2004 and 2009. This curriculum has been highly acclaimed, achieving 100% overall student satisfaction in the four consecutive National Student Surveys of 2011 - 2014. In recent years postgraduate taught programmes in Endodontics, Fixed & Removable Prosthodontics, Oral & Maxillofacial Surgery, Orthodontics and Primary Care Dentistry have been added to the teaching portfolio.

The Dental Hospital & School building in Sauchiehall Street has been undergoing an extended period of upgrading in recent years. NHS Greater Glasgow & Clyde has invested heavily in infrastructure and clinical facilities whilst the University has concentrated on investments to upgrade teaching facilities. The lecture theatres, seminar rooms, library, student common room and pre-clinical skills facility have all been refurbished. In 2012 a multi-media training facility was completed and named in honour of Professor Dorothy Geddes and in October this year a new combined Clinical Research Facility and Life-support Simulation Training Facility will be opened and named after Dr Jim Rennie.

There is one remaining Dental School teaching facility which is not fit for purpose and which is the subject of our current fund-raising. This is the Prosthodontics Teaching Laboratory, an area in which students spend a significant amount of time learning about the technical aspects of constructing dental prostheses, both fixed and removable. The images and narrative below summarise how major advances in both technology and teaching methods dictate the need for establishment of a new integrated Dental Technology Teaching Suite to replace the existing ageing laboratory.

### **What is Dental Technology?**

Dental technology is a branch of health technology which deals with the design, fabrication and maintenance of dental, oral and oro-facial appliances to replace missing parts of the dental and

oro-facial tissue following loss through pathological processes or surgery, or to underpin orthodontics or dento-facial orthopaedics. It provides an essential component of patient care for those receiving treatment involving prosthodontics, placement of crowns and bridges, orthodontics or maxillo-facial prosthetics, disciplines which frequently operate in concert to satisfy complex treatment plans. Dental technologists work very closely with dentists as part of the dental team and for this reason dental technology is a fundamental component of the BDS curriculum. Its scope extends from construction of a ceramic crown for a single tooth to the construction of large maxillofacial devices for patients who have suffered major trauma or mutilating surgery for head and neck cancer. The exceptional advances in recent times in materials science, 3D imaging and information technology have all impacted very significantly on the discipline. From the perspective of the clinician, these technological advances have greatly influenced the disciplines of Restorative Dentistry, Orthodontics and Oral & Maxillofacial Surgery, all of which are very reliant on dental technology services. For these reasons it is essential that a modern dental school has both the facilities and skilled staff to teach dental technology at a high level.

## **What's changed?**

### *What we teach*

The General Dental Council provides a blueprint for the Intended Learning Outcomes for dentists who wish to register to practise in the UK, and all dental school curricula need to reflect these ILOs. A number of the prescribed ILOs, which are listed in the GDC document *Preparing for Practice* (published in 2012), relate to dental technology. Thus, registrants must be able to:

- Apply to the practice of dentistry principles that derive from the biomedical, behavioural and **materials** sciences.
- **Restore the dentition**, where appropriate, using the principle of minimal intervention, to a standard that **promotes the longevity of the restoration or prostheses**.
- Manage restorative procedures that preserve tooth structure, **replace missing or defective tooth structure**, maintain function, are aesthetic and long lasting, and promote soft and hard tissue health.
- Assess the need for, design, prescribe and provide **biomechanically sound partial and complete dentures**.
- Recognise and explain to patients the range of **implant treatment options**, their impact, outcomes, limitations and risks.

As for all healthcare workers, dentists must be able to evaluate the need for more complex treatment and refer accordingly, which in turn requires in-depth understanding of the rapidly changing world of dental technology.

### *Advances in materials and clinical techniques*

Significant advances in biomaterials research have allowed Restorative Dentistry to enter the “post-amalgam era” through the use of nanotechnology to develop composite resin materials and porcelains and the generation of a hard tissue bond between tooth material and restorative materials.

### *Advances in technology*

Computer-aided design (CAD) and computer-aided manufacturing (CAM) have progressed over recent years from being ‘unreliable’ to become ‘mainstream practice’ resulting in indirect restorations accurately replicating the complex topography of tooth structure. A wide range of ceramic restorations can now be produced which provide improved mechanical properties, improved marginal integrity and enhanced aesthetics compared to traditional techniques. Advanced scanning, laser sintering, milling and 3D technologies are among those revolutionising clinical practice, as reflected in the case presentation below, and the reliability and predictability of dental implant placement procedures has been greatly enhanced by digital imaging methods. Orthodontic practice is also changing through computer-assisted appliances for tooth movement, for example Invisalign™ computer-generated therapy.

### *How we teach it*

Methods for teaching dental technology in Glasgow have changed significantly in recent years, driven largely by the research, scholarship and publications of our current staff. Introduction of innovative pedagogical techniques in the areas of practical skills development, assessment and feedback, and group-work dynamics were recognised with the award of a Teaching Excellence Award to Dr Donald Cameron and Mr Robert McKerlie in 2012, for careers distinguished by significant and sustained commitment to excellence in teaching. Furthermore, the hard work and commitment of the teaching staff in this area has been acknowledged by the University Student Representative Council’s Student Teaching Awards, in which Prosthodontics was runner-up in the category of Best Subject Area in 2011/12 and Orthodontics won the Best Subject Area category in 2012/13. The new flexible design of the planned teaching suite will ensure that the space is fully utilised to optimize teaching delivery using the innovative methods pioneered in Glasgow.

### **The new facility**

There has been an explosion in new technologies that are revolutionising dentistry both at the chair side and in the laboratory methods available to support the clinician. The current ‘Prosthodontics Teaching Laboratory’ was designed for a previous era and a fundamentally different, integrated ‘Dental Technology Teaching Suite’ is required in order to deliver a student-centred experience that ensures a detailed understanding of modern dental technologies.

The integrated technology suite would provide both undergraduates and postgraduates with a state of the art facility that is both versatile and fit for purpose. It will provide the opportunity to link clinical and laboratory teaching in the pre-clinical setting, supported by the new digital technologies. The IT facilities will bring the practical task demonstration directly to the student by means of individual workstation screens and provide opportunity for harnessing of digital solutions, such as 3D scanning, for treatment planning and analysis. The flexible design will ensure that the space is fully utilised in ways that have proved effective for student learning, for example syndicate group-work. Ability to split the suite into two smaller areas will greatly increase the flexibility and intensity of use of the space. A similar approach used in the Dorothy Geddes Multi-media Facility resulted in a 280% increase in utilisation of the space.

Adjacent to the planned Dental Technology Teaching Suite is a recently refurbished Clinical Techniques Facility, with 49 'phantom heads' on which dental students practise a variety of clinical procedures and must attain competence before being permitted to treat patients. There is a large interface between the clinical techniques being taught in the Clinical Techniques Facility and the dental technology that would be taught in the new suite. The co-location of these facilities would help to cement the integrated nature of the BDS course in the minds of students, and the installation of digital technologies would provide the opportunity to truly link the laboratory teaching to the clinical techniques teaching. It would also provide an outstanding resource for postgraduate teaching of procedures such as implant placement and construction of the overlying prosthesis.

The core elements of the new suite will include:

- Replacement of all the traditional rows of benches with modern purpose-built 'island' benching that incorporates good lighting, and individual work spaces will support all aspects of dental technology, allowing a reduction in the number of work spaces from 58 to 35. Provision of 'island' benching will encourage student interaction in teaching sessions, allowing easier access for staff and providing a more open laboratory environment.
- New dust extraction units as part of each individual work-space, satisfying modern health and safety requirements.
- Replacement of the ageing handpieces.
- Installation of air conditioning to deal with the over-heating of the environment. This was successfully installed in the refurbished Clinical Techniques Facility and has made a major difference to the teaching environment.
- Installation of electrical and gas safety switches.
- Addition of audio function to the existing visual projection system and screens at each workstation.
- A room divider to allow more flexible use of the space.

## Illustrative Case

Maxillo-facial prosthetics is a discipline for which advances in dental technology have had a profound influence, developing in parallel with enhanced surgical techniques that greatly reduce morbidity and improve patient care. This branch of dental technology is involved in oral and facial reconstruction for people damaged by accident or disease. Team work involving the maxillofacial technologists, oral and maxillofacial surgeons, restorative dentists and orthodontists can yield exceptional results.

Figure 1 illustrates what was achieved for a 15 year old girl who was diagnosed with a large benign tumour (a myxoma) in the right body of the mandible. The maxillo-facial prosthodontic technologists produced a 3D model of the mandible (3) that was printed (2) from a CT scan (1). This provided an accurate basis for pre-operative planning of the procedure (4-6) including production of a silicone template, based on a mirror-image of the patient's healthy right mandible, to help the surgeons identify the best location from which to harvest the bone graft from the hip. Subsequent placement of implants within the graft (7) allowed the prosthodontist to construct a fixed partial denture (8). The patient is delighted with the result

