INDIRECT RESTORATIONS AND REMOVABLE PROSTHODONTICS

DELPHI-STYLE SURVEY

Dear colleague,

With the aim to provide UK Dental Undergraduates a systematic education based upon current best evidence, we have developed an undergraduate curriculum for **Indirect Restorations and Removable Prosthodontics**. Although European curriculum guidelines for undergraduate students have been developed in other dental fields, none exist for Prosthodontics. Therefore, the British Society of Prosthodontics (BSSPD) has formed a working group to develop an undergraduate prosthodontic curriculum. Primarily this is aimed at UK dental undergraduate students however we welcome comments from our European colleagues in the hope that their input will make this curriculum accessible for everyone involved, including programmes across the wider world.

The curriculum follows the ADEE Graduating European Dentist (GED) curriculum by following a behaviour-based learning outcome approach.

Included are the capability domains of:
   i)   knowledge of the scientific and evidence-base
   ii) general prosthodontic learning outcomes
   iii) indirect restorations
   iv) removable prosthodontics.

The proposed curriculum has taken into account the Delphi consensus reported by Khalaf et al. 2022[2] to represent recently agreed important content in an undergraduate prosthodontic curriculum. Papers reporting curricula for digital workflows[3] and artificial intelligence[4] have also been taken into account.

Findings from this survey will establish how *clear*, how *important* and how *difficult* each learning outcome of the proposed curriculum is perceived to be. It is expected that the consensus view on these aspects will help educators to use the document to maximum effect when deriving local curricula. The process of deconstructing more complex tasks and teaching essential skills early, and reinforcing longitudinally, is described previously by Field *et al* 2022[1]

Introduction to Learning Outcomes

Learning outcomes are defined as "a series of individual and objective outcomes, with shared ownership between students and staff, designed to facilitate the learning and assessment process"[5]. They are very much a guide for students to direct their own learning, and for educators to plan a course of study, and to formulate assessments.

Within each capability domain, every learning outcome and has been highlighted as blue, green or yellow to represent the ideal educational environment and assessment style to achieve each individual learning outcome:

Clinical LO – directly observable within a clinical or skills environment
Supporting Clinical LO – directly observable within clinical or skills environment, or through case-based discussion, or written assessment
Fundamental LO – assessable through discussion or written assessment

Introduction to Competencies

Competencies are defined as "a professional behaviour or skill required by a graduating Oral Health Professional in order to respond to the full range of circumstances encountered within their professional practice"[5]. As such, competencies may comprise a number of discrete learning outcomes that require application to a scenario or task.

After each section of behaviour-based learning outcomes, a number of suggested competencies are listed.

Final comments

There is the opportunity to provide free text comments for any additional suggestions or comments. Completion of this survey should take around 20 minutes.

Participation in this project is voluntary. All survey responses are anonymous, no personal data will be collected. Due to the anonymous data collection, it will not be possible to remove your submitted responses at a later date. The data will be collated and presented in the form of descriptive statistics.

1. Field, J, Dixon, J, Towers, A, et al. Defining dental operative skills curricula: An ADEE consensus paper. Eur J Dent Educ. 2021; 25: 405–414. https://doi.org/10.1111/eje.12595
2. Khalaf KA, Moore C, McKenna G, Da Mata C, Lynch CD. Undergraduate teaching and assessment methods in prosthodontics curriculum: An international Delphi survey J Dent. 2022 Aug:123:104207.
3. Zitzmann NU, Lea Matthisson L, Ohla H, Joda T. Digital Undergraduate Education in Dentistry: A Systematic Review Int J Environ Res Public Health. 2020 May; 17(9): 3269.
4. Schwendicke F, Chaurasia A, Wiegand T, Uribe SE, Fontana M, Akota I, Tryfonos O, Krois J; IADR e-oral health network and the ITU/WHO focus group AI for health. Artificial intelligence for oral and dental healthcare: Core education curriculum J Dent. 2023 Jan:128:104363.
5. Davies, JR, Field, J, Dixon, J, et al. ARTICULATE: A European glossary of terms used in oral health professional education. Eur J Dent Educ. 2023; 27: 209–222. doi:10.1111/eje.12794
6. Field, JC, Kavadella, A, Szep, S, Davies, JR, DeLap, E, Manzanares Cespedes, MC. The Graduating European Dentist—Domain III: Patient-Centred Care. Eur J Dent Educ. 2017; 21(Suppl. 1): 18-24. https://doi.org/10.1111/eje.12310

Capability Domain 1: **Knowledge of the scientific and evidence-base**

This domain encompasses the scientific knowledge base relevant to indirect restorations and prosthodontics expected of a UK dental graduate.
This section follows the Association for Dental Education in Europe (ADEE) Graduating European Dentist (GED) advice, within Domain 3[6]:
"Sound scientific knowledge is critical for healthcare professionals to rationalise their treatment choices and offer patient-centred integrated oral health care"

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Supporting Clinical LO – directly observable within clinical or skills environment, or through case-based discussion, or written assessment
Clinical LO – directly observable within a clinical or skills environment

Learning outcomes

A graduating Dentist must be able to apply the scientific knowledge base relating to:

Fundamental LOs	K001	The aetiology, pathology, diagnosis and management of oral diseases and disorders including (but not exclusively): i) caries, ii) tooth wear, iii) gingival, periodontal and peri-implant diseases, iv) apical periodontitis, v) temporomandibular joint dysfunction and occlusal disharmony, vi) mucosal conditions and salivary pathology vii) developmental disorders of the hard tissues viii) oral cancer
	K002	Age-related changes in oral tissues and their associated functions
	K003	Social and behavioural sciences, including factors that facilitate the delivery of oral health care
	K004	The hazards of ionising radiation and the regulations relating to its use in Dentistry
	K005	Dental materials used in the clinical and laboratory stages for indirect restorations and removable prosthodontics - their properties, risks, benefits and limitations - including environmental/political/biocompatability issues relevant to their use
	K006	The survival and success rate associated with various types of indirect and removable restorative interventions, including dental implants and their associated restorations
	K007	The potential limitations, risks and benefits of dental technological procedures

	K008	The epidemiology (including incidence and prevalence) of acquired tooth loss, and the subsequent need for restoration with indirect restorations and removable prosthodontics
	K009	Various ideologies of occlusal design
	K010	The concept of the 'Shortened Dental Arch'
	K011	The 'Dahl' concept of relative axial tooth movement
Supp. Clinical LOs	K012	Communication and language development, specifically with patients who require special care
	K013	Sterilisation, disinfection and decontamination, and the core principles of infection prevention and control
	K014	Clinical, laboratory and other diagnostic procedures and tests
	K015	The impact of changes in oral health, and dental interventions, on the quality of life
	K016	Behaviour change, in relation to oral and general health

Capability Domain 2: **General prosthodontic learning outcomes**

This section covers diagnosis and risk assessment of the full range of dental diseases with a particular focus on caries, periodontal disease and tooth wear. It underlines the importance of using recognised classification and screening tools for effective diagnosis related indirect restoration and prosthodontic treatment. This section includes treatment planning for indirect restorations and removable prosthodontics, including the importance of preventative management as recommended by the GED.

A broad range of knowledge and clinical learning outcomes are covered including anatomy, biomaterials science, occlusion, special investigations, laboratory considerations, dental hard tissue disease, patient assessment, tooth assessment, the wider dental team and types of indirect restorations and removable prostheses.

Fundamental LO – assessable through discussion or written assessment
Supporting Clinical LO – directly observable within clinical or skills environment, or through case-based discussion, or written assessment
Clinical LO – directly observable within a clinical or skills environment

Learning outcomes

A graduating Dentist must be able to:

Fundamental LOs	P001	Discuss how various presentations of caries will impact on the treatment planning and prognosis of indirect restorations and removable prostheses
	P002	Discuss the main principles associated with planning and restoring moderate to advanced tooth wear
	P003	Describe the elements that comprise assessment for implant provision (relating to the hard and soft tissues), and discuss various risk factors for each
	P004	Discuss the indications and contraindications for prescribing relative axial tooth movements when managing the worn dentition
	P005	Explain the benefits of accurate study models and diagnostic processes in the planning process when managing tooth wear, indirect restorations, and removable prostheses
	P006	Explain the problems of associated with inaccurate or distorted impressions, how these most frequently occur, and how to best prevent this from happening

	P007	Describe the anatomical factors determining the movements of the mandible including the temporomandibular joint complex, muscles of mastication and occlusion
	P008	Describe the concept of a mutually protective occlusion, and the features of occlusal schemes that demonstrate canine guidance, and group function
	P009	Define the terms Intercuspal position (syn. centric occlusion), Retruded arc of closure (syn. centric relation), Retruded contact point, Occlusal Vertical Dimension, and Freeway space
	P010	Describe the ways in which genetic and developmental disorders of teeth can present, and the potential impact on oral health and the delivery of care
	P011	Describe the concept of a digital workflow, and explain how it can be used to create or facilitate the construction of indirect restorations and removable prostheses
	P012	Describe the ways in which AI can be utilised for prosthodontic planning, including the benefits and limitations of using such technologies
	P013	Describe the biomechanical consequences of poorly-designed fixed and removable prostheses
	P014	Explain how dental articulators and ear/facebows are classified and used, and in which cases each should be employed
Supp. Clinical LOs	P015	Describe the mechanical properties of dental materials commonly used for indirect restorations and removable prosthodontics and explain how these materials are fit for purpose in different clinical scenarios
	P016	Discuss the potential anatomical, aesthetic, functional and psychological effects of tooth loss
Clinical LOs	P017	Correctly decide when to refer patients with complex treatment needs
	P018	Explain to patients the ways in which teeth can be replaced (including implants) and discuss the risks and benefits of each approach, including estimates of longevity or success
	P019	Apply the knowledge of indirect and removable restoration types, their risks and benefits in any given scenario, to formulate an appropriate patient-centric treatment plan
	P020	Acquire the necessary information in order to decide whether teeth are suitable to be considered as abutments for fixed and removable dental prostheses
	P021	Acquire an accurate and relevant patient history particularly in relation to problems associated with the hard tissues, or existing prostheses - including social and pain histories, preventive regimes, dietary habits and relevant aspects of the medical history
	P022	Execute and record an accurate clinical examination with particular focus on restorative elements – such as hard and soft tissue charting, screening for periodontal disease and tooth wear, and a basic occlusal assessment

P023	Appropriately request and report on special tests, or investigations, in relation to the dental hard tissues
P024	Formulate appropriate diagnoses relating to the restoration or replacement of the teeth
P025	Develop a patient-centred treatment plans, by comprehensively discussing all available treatment options, including their expected risks, benefits and longevity
P026	Maintain open and effective channels of communication with the technical team when prescribing, designing and constructing indirect restorations and removable prostheses
P027	Correctly screen for tooth wear and discuss how early, moderate, and severe presentations are typically managed

Competencies

- Obtaining an accurate and comprehensive patient assessment
- Deriving a patient-centric treatment plan
- Carrying out a basic occlusal assessment
- Deriving a patient-centric risk assessment (across various domains)
- Obtaining valid patient consent
- Obtaining basic records (models, photos)
- Making an assessment of tooth restorability

Capability 3: **Indirect restorations**

This section outlines the learning outcomes and competencies expected of a UK dental graduate in relation to indirect restorations.

Fundamental LO – assessable through discussion or written assessment
Supporting Clinical LO – directly observable within clinical or skills environment, or through case-based discussion, or written assessment
Clinical LO – directly observable within a clinical or skills environment

Learning outcomes

A graduating Dentist must be able to:

Fundamental LOs	I001	Explain the basic laboratory procedures associated with fabrication of indirect restorations
	I002	Describe the ways in which missing tooth tissue can be managed indirectly, including with crowns, inlays, onlays, veneers and posts and cores.
	I003	Describe the ways in which missing teeth (and their associated functions) can be managed with bridges or dental implants
	I004	Explain the concept of a ferrule, and where on a tooth this feature is most important for any given type of indirect restoration
	I005	Explain the principles of tooth preparation and ideal occlusal design, relating to indirect restorations
	I006	Rationalise approaches to tooth preparation in relation to indirect restorations
	I007	Correctly describe the types of preparation or adjustment required for indirect restorations manufactured in metals and ceramics
	I008	Define a luting agent, and a dental cement - and describe their mechanism of action in retaining restorations
	I009	Explain the various approaches to resin bonding to natural tooth tissues and restorative biomaterials
	I010	Describe the various types of intra-radicular post (direct, indirect, surface features, shape, method of cementation) and the risks, benefits and likely impact of each in any given case
	I011	Describe the ways in which the gingival tissues can be managed and manipulated in order to obtain accurate records for the construction of indirect restorations
	I012	Discuss the intended functions of a well-constructed provisional restoration and the potential advantages and disadvantages to laboratory and chair-side construction

	I013	Discuss the various ways in which diagnostic wax-ups can be used to aid in the planning and placement of indirect restorations
	I014	Discuss the range of pontic designs and how these effect aesthetics, mechanical properties and cleansability
Supp. Clinical LOs	I015	Justify choices of lute/cement when fitting indirect restorations
	I016	Justify choices regarding which teeth could act as abutment teeth when designing fixed prostheses
	I017	Rationalise the use of intra-radicular posts, and discuss their risks and benefits when restoring teeth
	I018	Understand how to deconstruct different interim and definitive indirect restorations
	I019	Discuss the indications and contraindications for indirect restorations, including crowns, onlays, inlays, bridges, posts, cores, and veneers
Clinical LOs	I020	Correctly assess the level of restorability of broken-down teeth and incorporate this information appropriately into the treatment planning process
	I021	Consider the interface between indirect restorations, removable, and direct prosthetics when treatment planning
	I022	Effectively prepare hard tissues to receive indirect restorations of varying complexity, including crowns, veneers, and inlays/onlays and bridge retainers
	I023	Identify appropriate mechanisms for bonding restorations, across a range of clinical scenarios
	I024	Effectively prepare and place an intra-radicular post and an associated core material
	I025	Obtain accurate working impressions and adjuncts (registration, opposing impression) for the construction of indirect restorations
	I026	Effectively construct and place chair-side provisional restorations for indirect restorations
	I027	Provide accurate records for, and effectively prescribe diagnostic wax-ups from the laboratory

Competencies

- Single Crown workflow (assessment, preparation, impression, provisional, fit)
- Resin-retained bridge workflow (assessment, impression, provisional, fit)
- Conventional bridge workflow (assessment, preparation, impression, provisional, fit)
- Inlay/onlay/veneer workflow (assessment, preparation, impression, provisional, fit)
- Indirect restoration of the endodontically-treated tooth workflow (assessment, preparation, provisional, fit)

Capability 4: **Removable Prosthodontics**

This section outlines the learning outcomes and competencies expected of a UK dental graduate in relation to removable prosthodontics.

Fundamental LO – assessable through discussion or written assessment
Supporting Clinical LO – directly observable within clinical or skills environment, or through case-based discussion, or written assessment
Clinical LO – directly observable within a clinical or skills environment

Learning outcomes

A graduating Dentist must be able to:

Fundamental LOs	R001	Explain the basic laboratory procedures associated with fabrication of removable prostheses
	R002	Describe the ways in which missing teeth and soft tissues (and their associated functions) can be managed with removable dental prostheses
	R003	Explain the benefits of retaining healthy tooth roots as overdenture abutments
	R004	Rationalise approaches to tooth preparation or adjustment required for the provision of removable prostheses
	R005	Describe the benefits and limitations of using permanent and temporary registration bases
	R006	Discuss the value of utilising hard and soft tissue support when designing partial dentures
	R007	Discuss the physical and psychological benefits of retaining healthy roots as overdenture abutments
	R008	Explain the value of considering direct and indirect restorations as part of a treatment plan to provide removable prostheses
	R009	Correctly explain the clinical and laboratory processes for constructing complete, partial, immediate and copy dentures
	R010	Undertake clinical procedures necessary for repair, relining and addition of teeth to partial and complete dentures
Supp. Clinical LOs	R011	Rationalise approaches to material use, for hard and soft tissue support, when designing partial dentures
	R012	Justify choices regarding which teeth are able, or unable, to support axial loading when designing a tooth and mucosa-borne prostheses
	R013	Follow a systematic approach to partial denture design and rationalise choices for each specific denture component in any given case
	R014	Accurately prescribe a partial denture design to the laboratory

	R015	Effectively troubleshoot problems with the fit or accuracy of denture bases and frameworks
	R016	Correctly identify, and effectively troubleshoot problems presenting at the try-in stage of complete and partial prostheses
	R017	Discuss the ways in which patients might access or be eligible for the provision of implant-supported prostheses
Clinical LOs	R018	Acquire and quality assure accurate primary impressions of edentulous or partially dentate arches
	R019	Rationalise and appropriately prescribe a design for special trays for edentulous or partially dentate arches
	R020	Correctly adjust special trays for edentulous and partially dentate arches and acquire, and quality assure, an accurate functional impression
	R021	Explain the importance of, and acquire, an accurate preliminary occlusal registration prior to designing removable prostheses
	R022	Outline and appropriately record the main biometric markers that determine tooth position, when constructing removable prostheses
	R023	Correctly assess the fit of a cobalt-chrome (or resin pattern) denture framework
	R024	Accurately and passively record the maxillomandibular relationship of the jaws using partial or complete registration blocks
	R025	Accurately assess the wax try-in of complete and partial dentures
	R026	Discuss prognosis and manage patient expectations throughout the whole process of complete and partial denture planning and construction
	R027	Effectively deliver the fit of complete and partial dentures, also ensuring that patients understand the process of insertion and removal, denture care, and how to manage problems that might present in the early stages of use
	R028	Discuss with patients the concept of implant-supported prostheses as a method of improving retention and stability

Competencies

- Complete denture workflow (assessment, primary impressions, major impressions, registration, try-in, fit, review)
- Partial denture workflow (chrome) (assessment, preliminary registration & design, major impressions, framework try-in, registration, try-in, fit, review)
- Partial denture workflow (acrylic) (assessment, preliminary registration & design, major impressions, registration, try-in, fit, review)
- Immediate denture workflow