

## Functional implant occlusion

International Certificate Course in Dental Implantology

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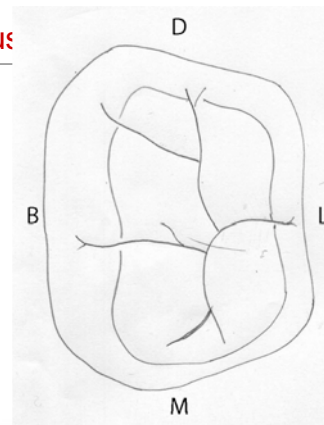
## Aims and objectives

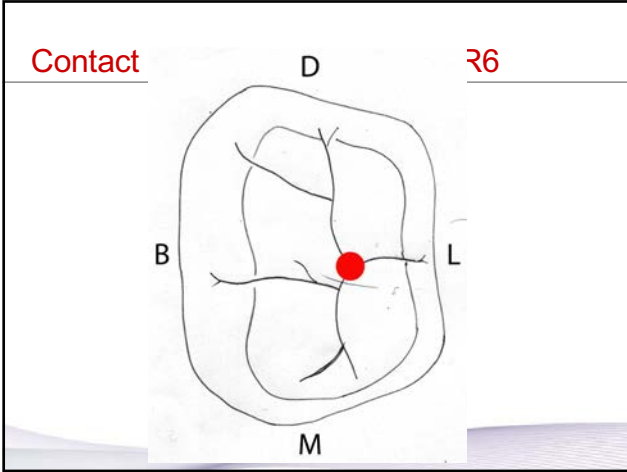
- overview of the principles of occlusion
- to discuss the differences between teeth and implants
- to highlight the importance of occlusion in implant dentistry
- to discuss practical aspects of occlusion in implant provision

## Thoughts on occlusion?

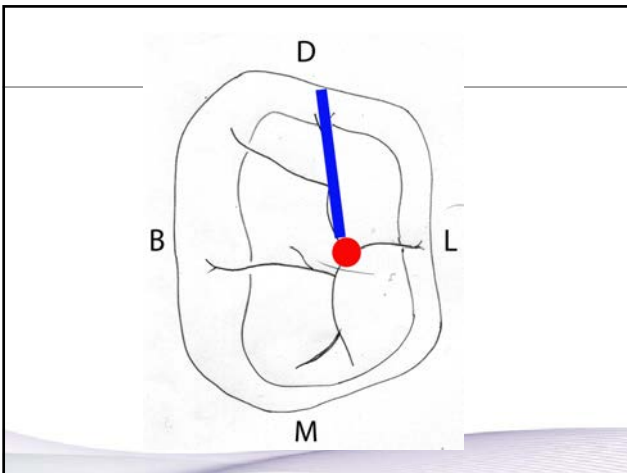
- no big deal?
- complicated
  - terminology
  - varied occlusal schemes
- panic
- tendency to avoid occlusal diagnosis at the outset
- sometimes occlusion is an after-thought, rather than a primary part of the treatment plan

## To get us

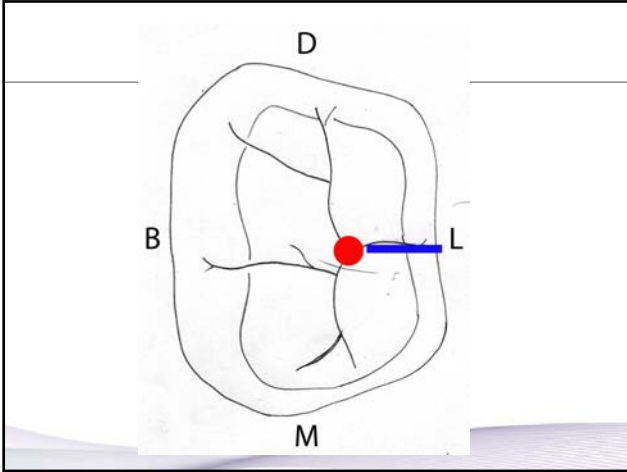




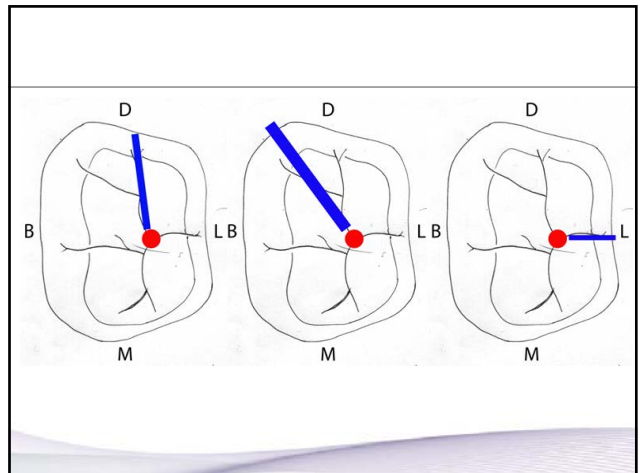
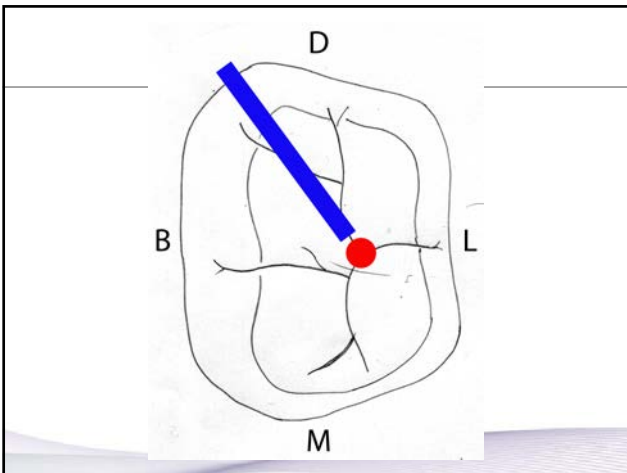
Draw an arrow that indicates the path of movement of the upper palatal cusp over the lower molar in a protrusive movement



Draw an arrow that indicates the path of movement of the upper palatal cusp over the lower molar in a working excursion



Draw an arrow that indicates the path of movement of the upper palatal cusp over the lower molar in a non-working excursion





## Occlusal terminology

- "occlusion" simply describes the relationship between opposing teeth in static and dynamic positions



## Occlusal terminology

- important terms include:
  - intercuspital position (ICP) – (*CO, MIP*)
  - centric relation (CR)
  - centric relation contact position/retruded contact position (CRCP) = (*RCP*)
  - Hv and Vh slides from CRCP to ICP
  - working and non-working contacts
  - anterior guidance

## Intercuspal position (ICP)

- this is the position of maximum intercuspation of the opposing teeth
- it is the "bite" that a patient normally adopts when asked to close their teeth together or when you put study models together
- sometimes described as **centric occlusion** or the position of "best fit"
- importantly, not always coincident with the first point of contact between the teeth
- acronyms: ICP, CO, MIP

## Centric Relation (CR)

- this is a jaw position/muscle position rather than a tooth position and occurs with the teeth out of contact
- describes the relationship of the mandible to the maxilla when the mandible is manipulated on its terminal hinge axis
- it occurs when the condyles are in their most superior position in the glenoid fossae, with their anterior surfaces functioning against the posterior facing surface of the glenoid fossa, irrespective of tooth position

## Centric Relation (CR)

- said to be a reproducible position of the mandible relative to the maxilla
  - used in occlusal examination and diagnosis to identify initial contacts and slides
  - to articulate study casts?
  - when adopting a reorganised occlusal approach
    - eg: making a set of complete dentures, restoring a wear case, Dahl-style

## Centric Relation Contact Position / Retruded Contact Position (CRCP/RCP)

- this describes the relationship of the mandible to the maxilla in which the initial contact between the teeth has occurred following closure with the mandible in centric relation
- CRCP is not necessarily coincident with the intercuspation position
- often present on a single pair of opposing posterior teeth
  - ..... but can be on any pair of teeth, anterior or posterior
- sometimes called **retruded contact position (RCP)**

### Centric Relation Contact Position (CRCP)

- the patient may have a deflective slide from CRCP into ICP
- significant when the tooth being restored is the tooth carrying the CRCP contact
- need to avoid introducing a new contact/slide on an implant crown

### Hv and Vh slides from CRCP to ICP


- deflective slides from CRCP into ICP have a horizontal (H) and vertical (V) component
- slides with a larger vertical than horizontal component are termed Vh slides and are simple to adjust
- slides with a larger horizontal than vertical component are termed Hv slides and are more complicated to adjust

### Hv and Vh slides from CRCP to ICP

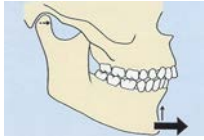
- significant if the contact or slide from CRCP into ICP involves the tooth or area being restored
- if a CRCP contact or slide is altered, for example during tooth preparation, this may allow the condyles to relocate or the path of closure to change, producing a change in the intercuspal position and possibly causing the new crown to appear 'high'

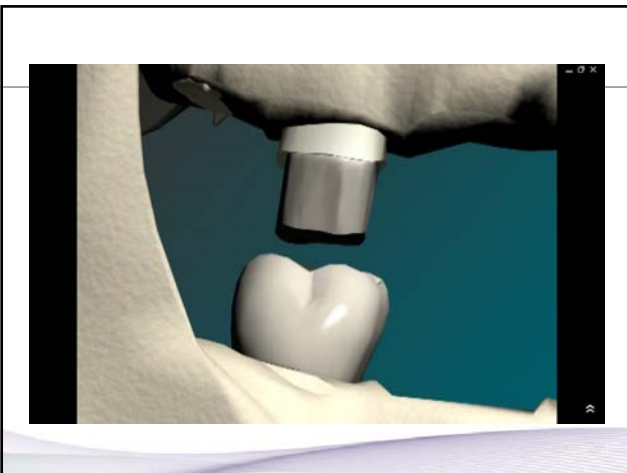
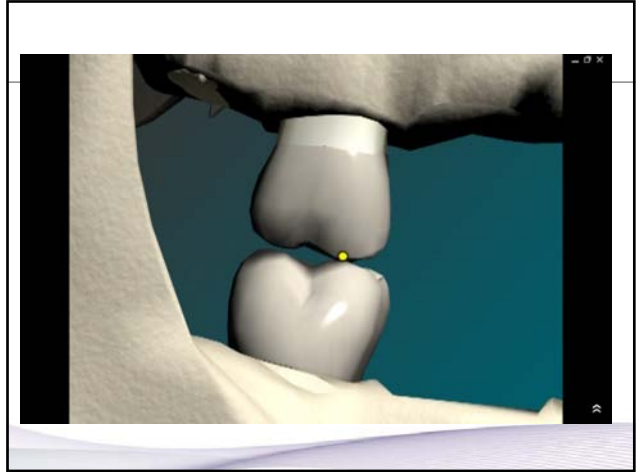
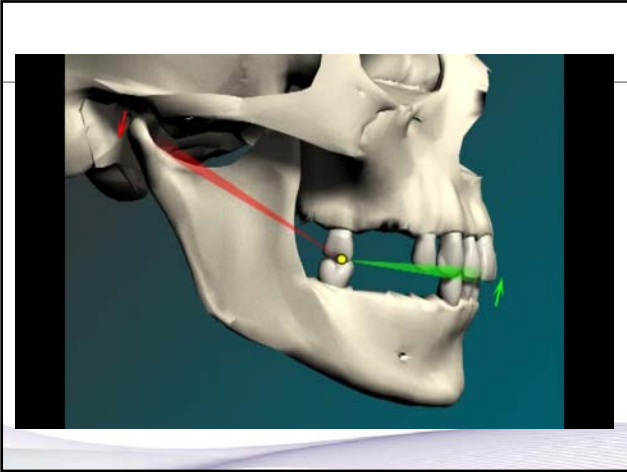
### Slides

Large vertical small horizontal



Large horizontal small vertical





- animation

## Working contacts

- working contacts are contacts occurring between opposing pairs of teeth on the side to which the mandible is moving
- working contacts may occur on single pairs, such as in **canine guidance**, or between groups of two or more opposing pairs, known as **group function**
- working contacts can be either guiding or interferences

## Non-working contacts

- non-working contacts are contacts occurring between opposing teeth on the side away from which the mandible is moving
- non-working contacts are sometimes termed '**interferences**', but this is not necessarily the case. Non-working contacts may provide the primary lateral guidance
- can cause problems if a NWC which is providing the primary guidance fails after implant treatment, where does the guidance go?
- non-working contacts need to be identified as they could cause problems if unknowingly removed during tooth preparation

## Why does guidance matter?

- teeth are loaded non-axially during guidance
- fractured teeth
- accelerated local wear
- tooth migration
- tooth mobility
- pain
- TMD
- cracks



## Occlusal diagnosis

- preoperative occlusal assessment important for case planning reasons and also medicolegally
- the findings of the clinical assessment of the occlusion should be recorded in writing in the case notes
- important to identify excursive contacts and slides, as these slides can create unfavourable force vectors
- important to consider occlusal aspects related to the failure of the tooth being replaced

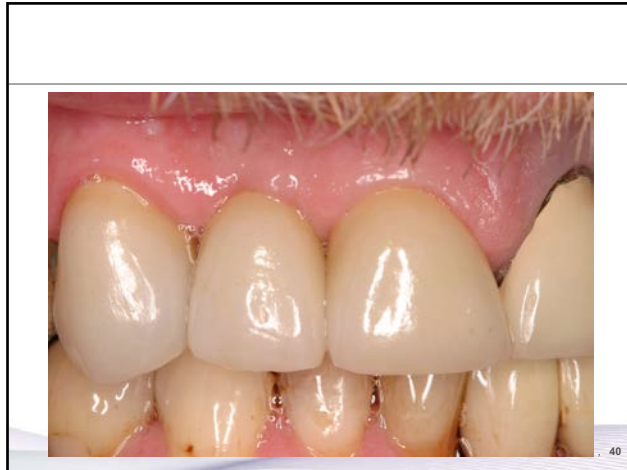
- important for consent purposes, eg: to inform a patient that the loss of an adjacent tooth with unfavourable occlusal issues could adversely affect the proposed implant
- aids in the planning and design of the final implant crown, eg: shape, width, cusp angles, etc

## How?

- clinical examination
  - working, non-working contacts, protrusion, CRCP, slides
  - use shimstock & articulation papers
- good quality study casts, mounted in ICP or CR on an articulator?
  - good quality occlusal records – myoco wax?
  - semi-adjustable articulator?
- cross reference the clinical findings with the casts

## Use the findings to:

- assess the effect of the occlusion on the proposed implant
- assess the effect of the proposed implant on the existing occlusion – will the crown fit in the space or change the occlusion?
- plan pre-operative occlusal adjustments (composite tip build-ups, crowns, other occlusal adjustments?)
- plan the occlusal aspects of the implant restoration (palatal shape, crown width, cusp angles, length etc.)



## What are the principle differences between teeth and implants?

- lack of a periodontal membrane
  - proprioception
  - mobility and ability to move away from applied forces
- force vectors - forces concentrated on apical 1/3 of a tooth but on crestal bone on an implant
- signs of overload
  - tooth: mobility, pain, fracture, pdl, crown debond, sensitivity
  - implant: crown debond, fracture, screw loosening, bone loss

## Occlusion and implant dentistry

- the periodontal ligament provides a dampening or shock-absorbency function, allowing the teeth to cope with occlusal loads
- under lateral loads, natural teeth move quickly away from the direction of force by 50-100 $\mu$ m and then rotate near the apex. This biomechanical action reduces the lateral force on the bone and moves the load away from the bone crest and along the tooth root

- under load, an implant moves gradually and to a lesser extent (10-50 $\mu$ m) and sustains a higher proportion of the load concentrated onto the crest of the bone
- the presence or absence of the periodontal ligament is significant in the detection of the early phases of occlusal force between opposing teeth and implants

- the threshold of tactile sensitivity for an implant is eight times higher than for natural teeth, ie: a patient can perceive load eight times earlier on a natural tooth, compared to an implant-retained crown
- due to this reduced mechano-perception, implants are said to be more susceptible to occlusal overload
- the significance of this decreased perception is the potential for development of peri-implant bone loss and implant or restoration failure

## Occlusal schemes used with implants

- canine guided
- group function
- balanced
- mutually-protected
- lingualised

## Implant occlusion - single tooth/small bridge

- basics:
  - harmonize with the existing occlusion
  - avoid introduction of new working or non-working contacts
  - no involvement in CRCP (RCP) - ICP slides
  - light occlusal contacts
  - occlusal forces ideally directed down the long axis of the implant
  - "freedom in centric"

## What are light occlusal contacts?

- adjust crown to have light contacts in ICP with clearance of 30-40 $\mu$ m when patient gently closes together (3-4 sheets shimstock)
- adjust to allow 10 $\mu$ m (1 sheet shimstock) in "power clenching"
- if occlusal clearance is too great (>40 $\mu$ m), may get supra-eruption of opposing teeth
- check clearance at each 6/12 exam

## What are light occlusal contacts?



### What are light occlusal contacts?



### Implant occlusion - unilateral free end saddle (Kennedy class II)

- simple, but depends on size of the pontic space and on opposing teeth supra-eruption!
- occlusion supported by natural dentition
- anterior guidance provided by natural teeth, providing disclusion of the implant prosthesis in lateral excursions
- create light occlusal contacts in ICP
- no introduction of new working, non-working or protrusive contacts
- no involvement in CRCP-ICP slide

### Implant occlusion - bounded posterior saddle (Kennedy class III)

- simple
- occlusion supported by natural dentition
- anterior guidance provided by natural teeth
- light occlusal contacts in ICP
- no introduction of new working, non-working or protrusive contacts and no involvement in CRCP-ICP slide

### Implant occlusion - bilateral free end saddle (Kennedy class I)

- can be more complicated, depends on the size
- anterior guidance provided by natural teeth
- conflict between the need for stable posterior occlusal contacts and the need for light occlusal contacts against the implants
- ? link implants together
- no introduction of new working, non-working or protrusive contacts or involvement in CRCP-ICP slide
- need careful monitoring

### Implant occlusion – anterior bounded saddle (Kennedy Class IV)

- can be complicated, the larger the span, the more complicated it is!
  - UL1 (21) missing only? keep protrusive guidance on UR1 (11)?
  - UL1 and UL2 (21, 22) only? keep protrusive guidance on UR1 (11)
  - UR1 and UL1 missing (11,21)? may need to have protrusive guidance on the implants, consider lower tooth rotations/crowding
  - UR3-UL3 (13-23) missing? Protrusive and canine guidance on the implant prosthesis

### Modification of occlusal design for implant prostheses

- increased implant surface area and bone-to-implant contact?
- load sharing and splinting
- modification of load direction and implant angulation
- modification of occlusal anatomy

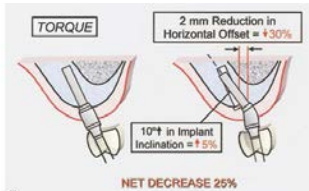
### Increased surface area

- increased bone-to-implant contact
  - more implants?
  - wider implants?
  - implant surface modifications
    - Plasma sprayed – very rough and ↑ surface area
    - Anodised – TiUnite
    - Grit blasted and etched

### Load sharing & splinting

- keep excursive loads on the natural teeth, bearing in mind adjacent teeth of poor prognosis (post crowns?)
- consider alterations to natural teeth (composite build-ups on canine tips, cusp adjustment, crowns?)
- in multi-unit cases, spreading the loads and guidance around the prosthesis
- splinting implants together, via linked prosthetic frameworks, will improve the force distribution and possibly allow the benefits of implant tripodism, reducing load and bending moments

## Modification of implant angulation and use of angled abutments



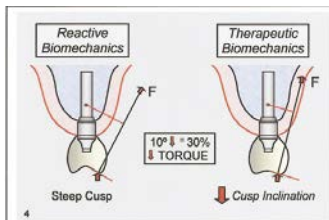
- angling the implant buccally will increase the torque by up to 5% however, the resulting reduction in horizontal offset, or ridge-lap, may then reduce the torque by up to 30%. Angled abutments can then be used to realign the prosthesis with the implant fixture (Weinberg 2001)

## Modifications to occlusal anatomy

- reduce bucco-lingual width of the crown, especially molar crowns
- freedom in centric occlusion – “jiggle room” anteriorly
  - wide fossae
  - shallow cusp angles
- posterior cross bites

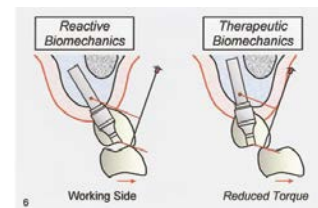


## Modification of crown cusp angles



- steep cusp angles produce increased torque on implant fixtures. For each 10° increase in cusp inclination there is a 30% increase in implant torque production use of posterior cross bites will also reduce implant torque (Weinberg 2001)

## Use of posterior cross-bites



- the use of posterior cross bites will also reduce implant torque (Weinberg 2001)

## Summary

- establish the importance of pre-operative occlusal assessment
- some thought given to final occlusal design of the implant crown at the outset
- harmonize with the existing occlusion
- light occlusal contacts (shimstock)
- occlusal design
  - shallow, smooth cusp angles, wide fossae
  - narrow bucco-lingual dimension