

Radiography with edentulous patients

- Background information about pans
 - 1 pan is equivalent to 6 PA's
 - Focal trough in the anterior is very narrow and posterior is broader. This means any errors in positioning will be more evident in the anterior region
- Indications for using a pan, according to ADA
 - Assessment of growth and development of the dentition at ages 6 and 12
 - Assessment of 3rd molars at age 18
 - Baseline assessment of the jaws of the edentulous patient – for prosthetics and implants
 - If pan is not available, you have to use PA's at a 25% reduced exposure
 - 14 PA's (size 2): central x1, lateral/canine x2, premolar x2, molar x2
 - Evaluate for jaw fractures
 - Evaluate lesions too large to show on PA
- Common mistakes to avoid
 - Selecting a larger sized setting than the patient → will capture too much of the spine which is not necessary
 - Metal objects will produce fuzzier "ghost images" on the contralateral side, superior to the original object
 - Ex: earrings, hearing aids, necklaces, other jewelry
 - Patient positioning
 - Frankfurt plane parallel to floor
 - Chin up: dentition shows a sad smile, eyes far apart, and palate arched downwards
 - Chin down: exaggerated smile, palate arched upwards, anterior mandible blurry
 - Head shifted, tilted, or rotated
 - Hard to differentiate in edentulous patients, but can use acoustic meati as reference points
 - Tilting is easier to see
 - Tongue touching the palate
 - If not, will generate the palatoglossus air space
 - Properly positioned antero-posteriorly
 - Positioned too anteriorly: eyes close together, vertebrae fully visible
 - Positioned too posteriorly: eyes far apart, vertebrae not visible
 - Objects anterior to the focal trough will appear squeezed and blurry
 - Objects posterior to the focal trough will appear widened and also blurry
 - Edentulous patients will go into a class 3 malocclusion when fully biting down, because they have no occlusal vertical dimension
 - This means the mandible or maxilla will be out of the focal trough
 - Patient needs to be open a little bit to get both arches in focus
 - Back should be straight, because slouching may cause ghosting of the spine
- Pan interpretation
 - Common findings
 - Impacted teeth, retained roots
 - Abnormalities of the ridge, pneumatized maxillary ridge
 - Condyle flattening or osteophytes
 - Other conditions
 - Residual cysts, infections, intrabony tumors
 - Bone spicules on ridge
 - Calcification of the carotid artery*
 - Systemic conditions affecting bone metabolism (like hyperparathyroidism decreasing bone density)
 - Panoramic images magnify structures by 20%, but varies depending on relation to focal area
 - If you don't know if a size abnormality is due to bad positioning or an actual abnormality, then look at teeth sizes (if present). If teeth sizes are the same bilaterally, the difference in size is more likely abnormal
 - Differential diagnosis of calcification C3~C4
 - Hyoid bone, calcified thyroid cartilage, calcified lymph nodes, calcified triticeo cartilage, non carotid phlebolites

Oral mucosal disorders in denture patients

- Resolution of oral mucosal problems
 - All lesions should be fixed prior to starting denture fabrication
 - Treatment can begin before treating mucosal issues, as long as the final impression is taken on a healthy mucosa
- Mucosal disorders

	Background	Symptoms	Treatment
Bone exostoses (also called tori, if on lingual/palatal side)	-Max: 20~25% of population -Mand: 6~12% of population -Positive link between mand tori and parafunctional habits	-Bony growths in mouth -Should not noticeably increase in size over time (if it does, suspect a neoplasm)	If growth is seen: -Image it (CB, CBCT, poured casts) -Ca/PO ₄ levels -PTH levels -Biopsy (not recommended as mucosa overlying tori heals poorly)
Epulis fissuratum (traumatic hyperplasia)	-Chronic trauma from an ill fitting denture	-Fibrous connective tissue growths in areas of trauma from denture	-If caught early (signs of inflammation), then removal of trauma will fix lesion -If stable (looks like normal tissue), then it needs to be excised
Inflammatory papillary hyperplasia	-Chronic trauma from an ill fitting denture -Poor hygiene -Denture overuse	-Fibrous overgrowths scattered over the hard and soft palate -Inflammation	-Improved denture and oral hygiene (brush palate daily) -Nighttime denture removal -Upper denture reline -Surgery if no resolution
Denture stomatitis	-Candida albicans infection due to poor fit, nighttime use, hyposalivation, or antibiotic use	-May be seen with IPH -More widespread redness than IPH	-Nystatin cream applied on denture before application -Nighttime removal -Improved hygiene -Upper denture reline
Allergic stomatitis	-Allergic reaction to metals or acrylic used in PRDPs	-Redness to metal or acrylic, not likely both	-Treat like a fungal infection first. If no resolution, might be allergic
Angular cheilitis	-May be due to systemic disorder or more commonly saliva leakage due to a loss of occlusal vertical dimension with dentures -Saliva leakage → candida albicans infection -Also linked to poor hygiene	-Inflammation at corners of the mouth -Usually bilateral	- First line: antifungal cream or ointment - If inflammation is significant: compounded topical corticosteroid + nystatin -Treat cause of angular cheilitis -Fix OVD of dentures and improve hygiene
Median rhomboid glossitis	-Candida infection of the tongue -Can be caused by a spread of candida infection from the palate (called a Kissing Lesion)	-Red, sometimes lobular area at the junction between the anterior 2/3 and posterior 1/3 of the tongue	-Clotrimazole lozenge 10 mg 5x/day x 14 days
Traumatic ulcer	-Localized trauma due to denture	-Ulcer	-Tissue conditioning reline -Denture adjustment -May require long term removal of dentures before final impressions are made
Hyper-keratosis	-Irritation due to a rough denture surface	-White keratotic epithelium	-Smooth denture -Consult oral medicine for possible dysplastic changes
BRONJ	-Bisphosphonates inhibit osteoclasts → ↓ bone turnover → necrosis -More severe with later generation bisphosphonates w. N sidechains -Long half life	-Bone degradation and deterioration -Risk can last for decades due to long half life of drug	-Optimal oral hygiene and CHX rinse -Bone fragments removed when loose and given antibiotics -Hyperbaric oxygen is not helpful
Carcinomas		-Indurations -Lymph node swelling	

Classification of edentulous patients

- Classification systems have existed for periodontics for 20+ years, and endodontics has made one as well
 - Allows the clinician to judge whether the case can be taken or would warrant referral
 - Classification is based on 4 main criteria and the patient is labelled a Class I, II, III, or IV
- Checklist for classification of edentulism

		I	II	III	IV
Mandibular bone height	>21mm				
	16~20mm				
	11~15mm				
	<10mm				
Residual ridge morphology of maxilla	Type A: resists vertical&horiz forces, hamular notch present, tori absent				
	Type B: no buccal vest, poor hamular notch, tori absent				
	Type C: no anterior vest, minimal support, mobile anterior ridge				
	Type D: no anterior/posterior vest, tori present, redundant tissue				
Mandibular muscle attachments	Type A: adequate attached mucosa				
	Type B: no buccal attached mucosa + mentalis muscle				
	Type C: no anterior B&L vestibule + genio + mentalis muscles				
	Type D: attached mucosa only in posterior				
	Type E: no attached muscosa, cheek/lip moves tongue				
Maxillo-mandibular relationships	Class I				
	Class II				
	Class III				
Conditions requiring pre-prosthetic surgery	Minor soft tissue procedures				
	Minor hard tissue procedures				
	Implants – simple				
	Implants with bone graft – complex				
	Correction of dentofacial deformities				
	Hard tissue augmentation				
	Major soft tissue revisions				
Limited arch interspace	18~20mm				
	Surgical correction needed				
Tongue anatomy	Large (occludes interdental space)				
	Hyperactive (with retracted position)				
Modifiers	Oral manifestations of systemic disease		Mild	Mod	Severe
	Psychosocial			Mod	Major
	TMD symptoms				
	Hx of paresthesia or dysesthesia				
	Maxillofacial defects				
	Ataxia				
	Refractory patient				

- If a patient falls in multiple diagnostic classifications, then pick the most severe one
- Mandibular bone can easily be measured on a panoramic, but it is much more difficult to get a consistent reading on the maxilla. Therefore, the maxillary bone is classified based on morphology instead
- For mandibular muscle attachments, having more muscle is bad because it will lift the denture out of place when the patient moves their mouth (like talking). Denture flanges need to be cut back not to interfere with muscles
- At UBC, it is recommended to refer class 3 or 4 and only work on class 1 or 2
- Aside: Patient personalities (House's classification)

	Philosophical	Exacting	Indifferent	Hysterical
Behaviour	-Accepts clinician's judgement without question -Generalized motivation	-Like philosophical patient -Methodical, precise, and demanding -Asks lots of questions -Requires extreme care from dentist	-Low motivation low desire for care -Little appreciation -Requires more explanation	-Emotionally unstable -Excitable, apprehensive, hypertensive -Blames world for current condition -Never satisfied
Compliance	-Pays attention and follows instructions	-Like philosophical patient	-Gives up easily -Uncooperative	-Always complains
Prognosis	-Best	-Excellent if intelligent and understanding -May require more time from clinician	-Good, if a family member takes ownership	-Poor -Dismiss

Denture care and maintenance

- Eating
 - Start with small pieces of food pre-cut with a fork and knife
 - Try to chew on both sides of mouth
- Cleaning
 - Keep mouth and denture surfaces clean
 - Dentures can be washed with soap + soft hand brush or a special denture brush at least once a day
 - Soak the dentures in a cleaning solution for a short time at least once a day
 - Commercially available denture cleaning solution OR
 - 1 teaspoon of bleach (5% NaOCl) diluted in 8oz (227mL) of water for 15 minutes max
 - Don't use products containing abrasives (like toothpaste) as it may scratch the polished surface of the denture
 - Brush the oral tissues (especially the ridge) with a medium toothbrush to clear biofilm
- Resting
 - Rest your mouth without the dentures as much as possible
 - Remove dentures while sleeping
 - To slow the growth of bacteria, store dentures in a dry container
- Other changes
 - Salivary flow will be increased for the first few weeks of using a denture, and will return back to normal
 - Minor irritations and sore spots are very common
 - Remove denture to ease pain if necessary
 - Wear denture few hours before seeing dentist so that the area of soreness can be seen easily
 - May have the sensation of gagging. If this persists, will need an adjustment from the dentist
- Talking
 - Speech may be disturbed for the first few days
 - Reading aloud may help adapt to the new denture
- Denture fit
 - Over time, the mouth tissues will change shape and dentures won't fit very well
 - Dentures will require re-lining and adjustments
 - Initially, dentures will be hard to use and it will be a learned skill before they feel comfortable
 - See the dentist once a year to assess fit and distribution of denture forces
 - Tell patient not to adjust dentures themselves
 - Assessing denture fit
 - Retention: resistance to displacement along the path of insertion
 - Stability: resistance to horizontal displacement due to one-sided forces or anterior/posterior forces
 - A severely resorbed ridge will lack stability/retention even with the best fitting dentures
- Relines
 - Resurfacing of the internal aspect of a denture to improve fit
 - Impression material is put inside the denture and placed in patient's mouth
 - When impression sets, it is sent to the lab and the impression material is replaced with denture base resin
 - Basically adding material to areas that shrank due to resorption
- If the patient has received extractions <1 year ago
 - Resorption is the fastest within 1 year of exodontia
 - Patient that receives complete dentures will most likely need a reline within 1 year
 - Relines will cost ~\$200 per denture
 - Educate patient about resorption to clarify expectations
 - Resorption can be minimized if posterior teeth are removed first → wait 3 months → do border molding → remove anterior teeth (resorbs less) → place dentures

Denture fabrication step 1 – Initial patient examination

- Medical information
 - Med/dent Hx, vitals, etc
 - Write patient's chief complaint verbatim and listen to their expectations
- Assess patient's previous denture and their experience using it (if present)
 - Dentist should assess patient's previous denture without the patient's opinion first
 - Assess esthetics, extensions, hygiene, OVD, retention, speech, and stability
 - Document any changes the patient requests and any changes you think are necessary
- Patient habits
 - Lifting denture with tongue
 - Clenching teeth
 - Wearing dentures at night
 - Educate patient about negative impacts of these habits and encourage change
- Mouth opening
 - <50mm from ridge to ridge means mouth opening is small
 - Small mouth opening has a poorer prognosis due to difficulty with border molding, impression taking, etc
- Resorption
 - Minimal, moderate, or severe resorption
 - Resorption may be severe enough on the mandible to expose the mental nerve in foramen – will cause pain
- Mucosal findings – see Dr Whitney's lecture
 - Epulis fissuratum, denture stomatitis, angular cheilitis, traumatic ulcer, hyperkeratosis, glossitis, cancer
- Vestibular depth
 - Deep vestibules without muscle interference is ideal
 - Frenectomies may need to be performed if frenum attachment is high
- Radiographic assessment
 - Impactions, root tips, radiolucencies
 - Mandibular bone height
 - Measure the area of least thickness. Ideally >20mm, but 16~20mm is okay. <16 will have problems
- Assess need for corrective surgery
 - Tori will need to be removed to get proper extension of denture
 - Even if the patient has good bone height, surgical correction will be required if there are undercuts
 - Frenum may need to be cut
 - Residual roots will need to be removed, if present
- Patient understanding
 - Patient must understand the prognosis
 - Prognosis may be different for upper/lower arches
 - Temper expectations with what can realistically be accomplished
 - Esthetics, function, and comfort expectations may be unachievable
- At UBC
 - At the initial appointment, the EPM examination form and informed consent form need to be completed
 - 3 step Tx plan must be generated
 - Phase 1 treatment
 - Patient requires oral hygiene and denture hygiene instructions
 - Mucosal disorders need to be treated
 - Current denture requires modifications
 - Phase 2 will be fabrication of a new denture
 - Phase 3 maintenance
 - Recall is usually every 1 year
 - Address the issues in phase 1, and make sure that they do not reoccur
 - Follow up on chronic conditions or treatment not accepted (like tori removal)
 - Address any negative habits
 - Reline or periodic remake (base damaged, teeth stained/worn, decreased retention/stability)

Impression materials

Classification	Material	Properties	Use
Rigid materials	Plaster of Paris	-Very rigid materials -Never used in dentulous patients as it may extract the teeth	-Edentulous patients with shallow or no undercuts
	Metallic oxide paste (ZOE)		
Thermoplastic materials	Modelling plastic	-Changes properties based on temperature	-Used for border molding in our course (green compound wax)
	Impression waxes		
Elastic materials	Reversible hydro-colloids (agar agar)	-Heated gel that sets as temperature is lowered -Easy to manipulate and easily applied	-Facial impressions (for facial prostheses)
	Irreversible hydrocolloids (alginate)	-Alginic acid that solidifies by forming insoluble calcium alginate -Accurate, easy, inexpensive, non toxic, no special tools needed -Good elastic properties -Water/powder ratio will not affect accuracy of impression, but it is critical for imp. strength	-Diagnostic and master PRDP casts -Pick-up impression techniques -Orthodontic casts, diagnostic casts, duplicating casts, etc -Most used material
	Polysulfides (rubber base)	-Rotten egg smell -Low/medium/high consistencies	-Preferred material but not used in school due to its difficulty
	Condensation silicones	-Short shelf life -Hydrophobic -Low/putty consistencies	-Releases EtOH during setting
	Polyethers	-Hydrophilic -Short shelf life	
	Addition silicones (vinylpolysiloxanes)	-Hydrophobic -Don't use latex gloves (interfere with the platinum catalyst) -Wait 30 minutes before pouring (H_2 gas released when setting)	-Most popular material

- Specific properties comparing elastic materials

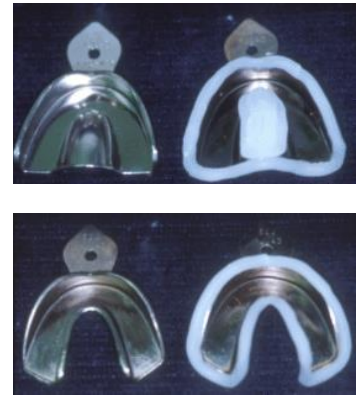
	Polysulfide	Polyether	Condensation silicone	Addition silicone
Components	- <u>Base</u> : polysulfide polymer and titanium dioxide - <u>Catalysts</u> : lead dioxide, dibutyl phthalate, sulfur	- <u>Base</u> : polyether copolymer and triglycerides - <u>Catalyst</u> : aliphatic cationic starter - <u>Both contain</u> : silica filler and plasticisers	- <u>Base</u> : Polydimethylsiloxane with hydroxyl group, fillers (calcium carbonate or silica) - <u>Accelerator</u> : liquid or paste of stannous octoate suspension and alkyl silicate	- <u>Base</u> : polymethylhydrosiloxane - <u>Catalyst</u> : platinum - <u>Both contain</u> : dimethylsiloxane polymer, vinyl terminal groups, fillers
Working time	3~7 min	2~3 min	2~4 min	2~4 min
Setting time	7~10 min	6 min	6~8 min	4~6 min
Mixing method	-Hand mixed	-Hand mixed -Auto mixed -Dynamic mech. mixing	-Hand mixed -Auto mixed	-Hand mixed -Auto mixed -Dynamic mech. mixing
Distortion @24h	-0.45%	-0.24%	-0.6%	-0.14%
Pouring	-Pour within 1 hour -One pour only	-Pour in 7~14 days -Multiple pours OK	-Pour in 15~30 min -One pour only	-Pour in 7~14 days -Multiple pours OK
Perm. deformation	1	2	2	4
Elastic recovery	4	2	2	1
Strain when compressed	4	1	3	2
Flow/wettability	1	2	2	4
Hardness	No change over time	Increases over time	Increases over time	No change over time
Tear strength	1	2	4	3
Creep compliance*	4	2	3	1

*Creep compliance: how quickly a material can recover from viscoelastic stress

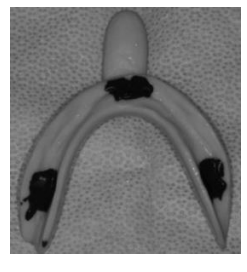
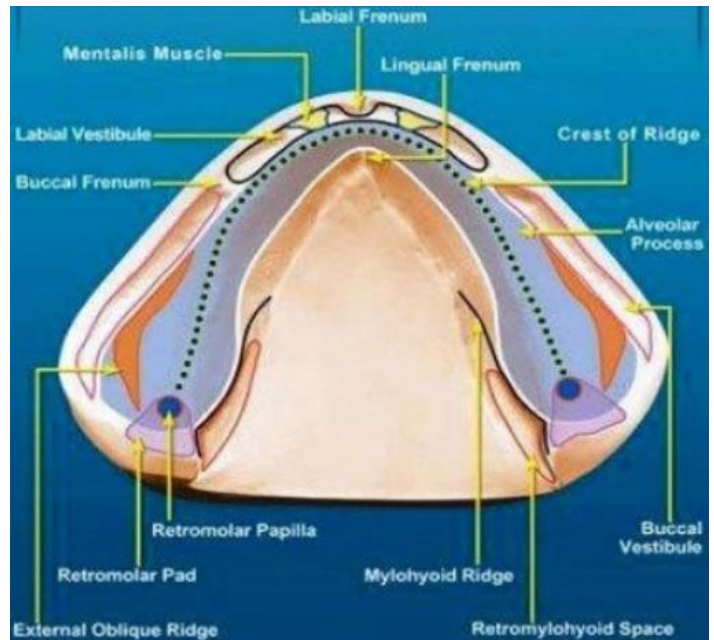
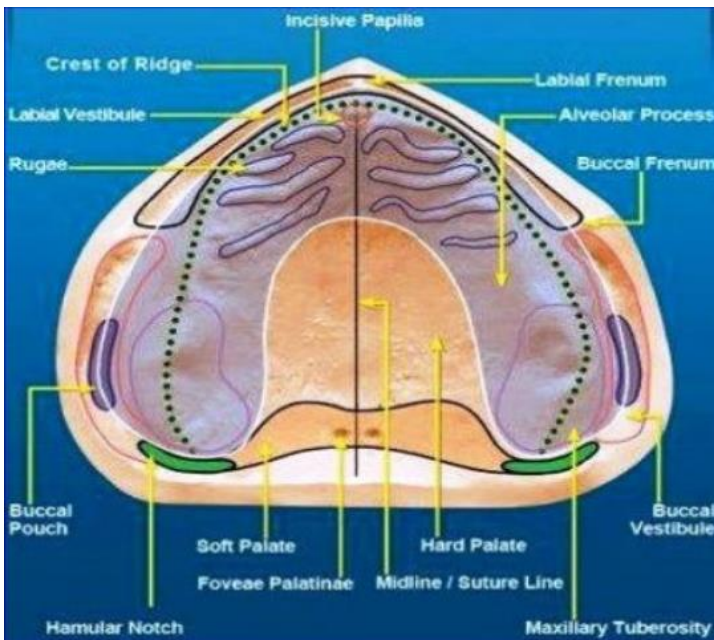
- Mixing techniques
 - Hand mixing: done with putties
 - Auto mixing: mixed when expressed through a mixing tip (via a gun). Less bubbling, consistent ratios (predictable setting time), consistent mixing, but more expensive
 - Dynamic mechanical mixing: machine automatically mixes and extrudes material through a nozzle
- Impression techniques
 - Simultaneous dual viscosity technique: low consistency material injected into critical areas with high consistency material placed in impression tray. Tray is then placed and held until material is set. 2 materials bond together
 - Single viscosity monophase technique: light~medium viscosity material only placed in tray, then placed in mouth. Hard to get sufficient details so not recommended for teeth prep impressions
 - Putty wash technique: putty impression taken first → areas of interest are cut away from impression to form a cavity → low consistency material is syringed in and reinserted into the mouth

Denture fabrication step 2 – preliminary impression and custom tray

- Alginate is the material of choice for primary impressions
 - Has ideal characteristics
 - Sets rapidly
 - Easily mixed with just water (remember mix powder into water)
 - No expensive equipment or tools are needed
 - Comes in 2 types:
 - Type 1 (fast set): mix for 45 seconds, 30~75 seconds to set
 - Type 2 (regular set): mix for 60 seconds, 2~3 minutes to set
 - Kromopan (type 1) is the brand used at UBC
 - Changes colour to indicate stage of setting
 - Purple → mixing stage
 - Pink → loading stage into tray
 - White → insert into patient's mouth to make impression
- Impression trays
 - Perforated edentulous trays are superior in capturing detail compared to non-perforated trays
 - Select a tray that leaves about 5mm between tray and soft tissues
 - For the maxillary, also make sure the tray reaches to the post-dam area and pterygomaxillary ligaments
 - Use wax to build up borders – captures more anatomy and acts as a cushion
 - If the patient has a deep palate, add wax on palate too
- Technique
 - Patient comfort: seated upright, lubricate lips, prepare kidney dish in case of gag reflex
 - If gag reflex is present, start with mandibular impression so patient can get used to it
 - Mandibular impression
 - Stay in front of the patient
 - Pull on one cheek with your index finger
 - With the other hand, insert one side of the impression tray, and pivot whole tray into the mouth
 - Ask patient to lift the tongue while you press from posterior → anterior
 - Patient can now relax the tongue
 - Maintain tray in place while you lift the lower lip with your free hand
 - Maxillary impression
 - Stand slightly behind the patient
 - Retract one cheek with index finger and pivot the tray in from the opposite corner
 - Press posterior → lift upper lip → press anterior → pull on upper lip to capture vestibule
 - Disinfection and pouring
 - Remove saliva, blood, and debris with water then tap off excess water
 - Surface should be coated with a disinfectant and placed in a sealable bag
 - After adequate disinfection time, should be poured immediately
 - If it cannot be poured immediately, place in bag wrapped in wet paper towels (100% humidity)
- Pouring alginate impressions
 - Pour in type 3 stone
 - Trim study cast with 2mm land areas
 - Draw tray extensions 2mm short of the functional vestibule depth on the cast
 - Block out undercuts with pink wax
- Custom tray
 - Can be fabricated by the lab or made in the clinic
 - If writing a prescription, follow:
 - Please fabricate custom trays in SR-Ivolin auto polymerizing acrylic resin following the line marked on the casts, no spacer. Return the study casts with custom trays by (date) at (time). Thank you.
 - Note any unusual extensions, undercut blockouts, and request a handle shape that won't interfere with the impression

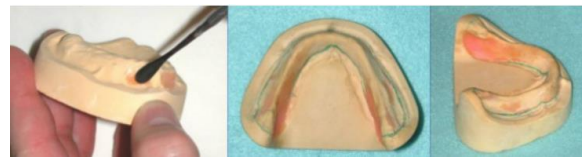
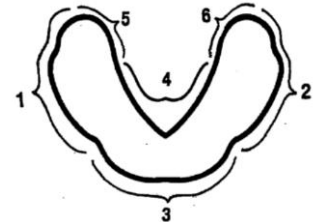


Denture fabrication step 3 – final impressions



- Custom tray criteria
 - Custom tray must be used to obtain a quality final impression
 - How deep should the custom tray be?
 - For complete dentures → 2mm away from the depth of the vestibule
 - For FDP's → 2mm below the gingival margin
 - If the tray is overextended, can be taken back using an acrylic bur
 - Make sure the tray does not dislodge when patient's cheeks are pulled and moved
 - Make sure the tray clears the frenum(s)
 - There should be no spacer when making the custom tray → spacer will be added via wax
- Final impression preparation
 - Make sure the patient has not worn dentures in the past 24 hours → tissues are at their uncompressed state
 - Since no spacer was used, use green stick compound and melt 3 blots (1mm thick each) on the custom tray
 - This separates the tray from the tissues, so impression material can be loaded
 - Border molding
 - Since the tray was 2mm away from the vestibule, green stick compound is used again on the peripheries of the tray to capture the exact position and anatomy of the vestibules
 - Melt green stick over a flame until it bends on its own weight (but not quite dripping)
 - Apply whole thickness of stick on border of custom tray
 - Make sure borders of tray are dried first, or else wax won't bind
 - Green stick will be too hot, so place in 50C water bath to bring down temperature
 - Green stick will harden but will still be very malleable → insert into patient's mouth at this state
 - Pull/push on patient's cheeks/lips to simulate normal jaw movements and mould the green stick
 - Ensure patient comfort at this stage, because the thickness of the border molds will represent the thickness of the final denture phalanges
 - Be aware of the frenum clearances (buccal and labial)

- Sequence of maxillary border molding
 - Right/left sides → mould by pushing/pulling cheeks and getting patient to move their jaw side to side
 - Anterior labial area → mould by pulling on lips and asking patient to do a sucking motion
 - Posterior palatal area (maxilla only) → called a “palatal seal.” There are 2 areas to capture
 - Anterior border: junction of hard and soft palate
 - Posterior border: junction of movable and immovable soft palate (vibrating line)
 - Having the denture go past the vibrating line will mean the denture will dislodge when the patient talks or swallows. May also cause a gag reflex
 - Wax is applied in a “cupid’s bow” shape to capture the posterior area
- Sequence of mandibular border moulding
 - Follow order seen in the picture →
 - Buccal shelf: buccal to the posterior ridge, it is an important area for denture support
 - Retromolar pad: second area for denture support, and also gives a reference for lower occlusal plane
 - Retromylohyoid area: lingual to the posterior ridge, it has a concavity which gives good denture retention
- Once all the border molding is done, you can remove the spacer
- Taking the final impression
 - Apply adhesive compound on the tray and load with light body PVS (heavy body will compress tissues)
 - Might have a void in the center of the palate → load some wax and press into patient’s mouth to capture this area
 - Do not need to redo a whole new impression
 - Disinfect impression, dry, and send to lab along with prescription
- Prescription for next appointment – making the record base
 - Example: “Please box the final impression and pour in type 3 stone to make the final cast. Make maxillary record base out of acrylic resin with a wax occlusal rim at a height of 22mm. Make mandibular record base out of acrylic resin with a wax occlusal rim at a height of 18mm. Thank you”
 - Record base materials can be HardWax, Shellac, acrylic resin, or Omnivac vinyl. Acrylic resin is preferred (rigid)
 - Record base is not the final base used in the denture
 - Acts as the base for the wax, and the wax is used to get occlusion dimension correct and place teeth
- If you were to make your own record base
 - Autopolymerizing acrylic resin is strong, accurate, but more technique sensitive
 - Light cure resin is quick, but brittle, more expensive, and may have issues retaining in patient’s mouth
 - Block out areas on the master cast using wax:
 - Undercuts, frenum areas, rugae, irregular surfaces, redundant tissue areas

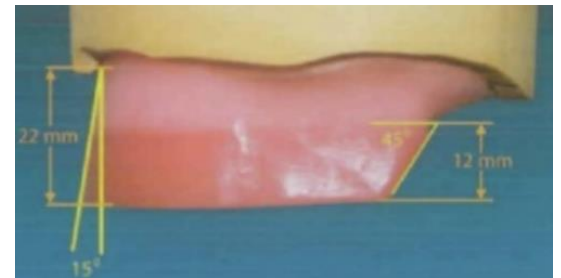


Denture teeth history



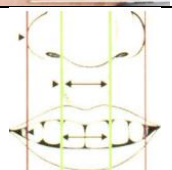

- 700 BC: Etruscans bridge
- 16th century: Japanese wooden dentures
- 16th century: Switzerland hinge ox-bone dentures. Ornamental use only, not for mastication
- 1728: 1st set of retentive complete dentures. Made of bone, ivory, or human teeth attached to metal framework
- 18th century: ivory dentures seen in Europe. Dentures of human teeth also made using extracted teeth off corpses from War of Waterloo
- 1770: Alexis Duchateau and Nicholas Dubois invent the porcelain denture fired to metal bases
- End of 18th century: porcelain dentures made in USA
- 1808: Guiseppangelo Fonzi invents “French Bean” teeth, which are individually fired porcelain teeth
- 1840: Samuel White improved on esthetics and retention
- 1913: Alfred Gysi creates anatomic tooth form, now known as Trubyte teeth 33 degree

Denture fabrication step 3 – Jaw relation records and wax rims

- Assessing record base quality – should be returned from lab
 - Should not rock on the master cast
 - Smooth, rounded, well polished
 - Thickness resembles those of finished dentures (uniformity)
 - Palate must be 1~2 mm thick
 - Contour and thickness of denture borders are defined by the land area of the master cast
 - Record base must not extend to land area of cast (or else it will impinge on muscles)
 - Critical areas are well captured
 - Lingual ridge of mandible is reinforced but concave
 - Retromolar pad area covered
 - Polished peripheries and palate
 - No porosity or voids
 - Flanges are smooth and rounded
 - Tissue surfaces are well adapted
- When the record base is completed, wax is added on the occlusal surface to form an occlusal rim. The purpose of the rim is to:
 - Allow recording of the facebow dimensions
 - Aid in anterior tooth placement/positioning
 - Aid in orientation of occlusal plane
 - Provide proper support for lips and cheeks when appropriately contoured
 - Used in determining the vertical dimension of occlusion
 - Used in taking tentative centric relation record
- Assessing wax occlusal rim quality
 - Wax thickness
 - Posterior rim = 8~10 mm thick B-L
 - Anterior rim = 3~6 mm thick B-L
 - Wax uniformity: no bubbles or voids, smooth throughout, smooth curvature following arch shape
 - Maxillary dimensions
 - 22mm thick anteriorly (including record base) with 15 degree buccal inclination
 - Buccal inclination is reduced in class 2 and increased in class 3 relationships
 - 12 mm thick posteriorly (wax only) with 45 degree buccal inclination
 - Incisal tip is 8~10mm anterior to incisive papilla
 - Mandibular dimensions
 - Lingual contours not impinging on tongue space
 - 18mm thick anteriorly (including record base) with 15 degree buccal inclination
 - 2/3 of retromolar pad height posteriorly
 - Rim centered over crest of ridge
 - Note: these are all “average” values to start with. They will need to be modified when the patient is seated



- Working on rims
 - Wax can be added using pink wax from dispensary
 - Wax can be removed by chipping a "paint scraper" and heating it → uniformly melts the whole plane
- Modifying the occlusion rim
 - Note: all measurements should be done with the record bases in the patient's mouth

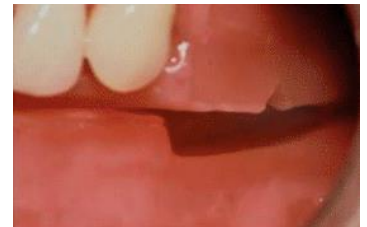
	What to check	How to check and modify (if needed)					
Maxilla	Height of incisors	<div>-At rest with lips slightly open, the edge of the maxillary rim should be visible</div> <div>-Add or remove wax to show teeth just below the upper lip</div> <div></div>					
	Lip and cheek support	<div>-Looking at a profile view, the angle between the nose and philtrum should be 90 degrees</div> <div>-Add/remove wax on the incisal region of the rim to get this relationship</div>					
	Occlusal plane	<div>-Place fox plane in patient's mouth, pushing it on the maxillary rim</div> <div>-Fox plane should be parallel to plane of eyes</div> <div>-Fox plane should be parallel to line from ala to tragus</div> <div></div>					
	Teeth positions	<div>-Stand directly in front of the patient and score the wax with the patient's midline</div> <div>-Mark the edges of the nose on the wax rim too → this indicates the 1/2 canine distance</div> <div></div>					
Mandible	Occlusal plane	<div>-Height falls between 1/2~2/3 of the retromolar pad</div> <div>-Make sure plane is in line with the maxillary (maxillary rim uniformly touches mandibular rim all the way around the arch)</div> <div>Effects of a poorly done occlusal plane</div> <table><tr><th>Plane too high</th><th>Plane too low</th></tr><tr><td><div>-Less maxillary teeth show (older appearance)</div><div>-Unstable lower denture</div><div>-Speech problems with F, V sounds</div><div>-Food trap under mand denture</div></td><td><div>-Excess display of maxillary teeth</div><div>-Unstable upper denture</div><div>-Speech problems with F, V sounds</div><div>-Possible gagging</div></td></tr></table>		Plane too high	Plane too low	<div>-Less maxillary teeth show (older appearance)</div> <div>-Unstable lower denture</div> <div>-Speech problems with F, V sounds</div> <div>-Food trap under mand denture</div>	<div>-Excess display of maxillary teeth</div> <div>-Unstable upper denture</div> <div>-Speech problems with F, V sounds</div> <div>-Possible gagging</div>
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Arch size	<div>-Maxillary arch should be consistently wider than the mandibular throughout the arch</div> <div>-This is to prevent patient biting their cheek when chewing</div>						
Both	Occlusal vertical dimension	<div>-Want to optimize esthetics, phonetics, and comfort</div> <div>-The tip of the nose and chin should be marked with a pen</div> <div>-The distance between these 2 points with a relaxed jaw is the <u>physiologic rest position</u> or <u>rest vertical dimension</u></div> <div>-The distance between these 2 points with a clenched jaw is the <u>occlusal vertical dimension</u></div> <div>-RVD – OVD = 2~4mm. This 2~4mm is called the <u>freeway space</u></div> <div>-In other words, there should be a gap between arches when the jaw is at rest</div> <div>Clinical tips</div> <div>-To achieve true rest, have the patient lick their lips, swallow, and relax. Repeat this a few times until a consistent RVD can be recorded</div> <div>-A tongue blade (popsicle stick) can be used to line up the eyes or ears/nose to see if it is parallel to the fox plane</div> <div>Effects of a poorly done OVD</div> <table><tr><th>Excess OVD</th><th>Decreased OVD</th></tr><tr><td><div>-Discomfort</div><div>-Trauma</div><div>-Clicking of teeth</div><div>-Poor appearance</div><div>-Loss of freeway space</div></td><td><div>-Inefficiency to chewing (overclose to chew)</div><div>-Cheek biting</div><div>-Appearance looking grumpy</div><div>-Angular cheilitis</div><div>-TMJ pain</div></td></tr></table> <div></div>		Excess OVD	Decreased OVD	<div>-Discomfort</div> <div>-Trauma</div> <div>-Clicking of teeth</div> <div>-Poor appearance</div> <div>-Loss of freeway space</div>	<div>-Inefficiency to chewing (overclose to chew)</div> <div>-Cheek biting</div> <div>-Appearance looking grumpy</div> <div>-Angular cheilitis</div> <div>-TMJ pain</div>
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- Phonetics tests should be done to ensure patient can speak with this occlusal rim setup

Sound type	Letter	Ask patient to say	About
Sibilant	S	Mississippi	-Space between incisors should be 0~2mm (but not quite touching) -Space too narrow → whistling sound is heard -Space too wide → lipping sound is heard
Bilabial	B, P, M	B, P, M	-Formed by stream of air that is uninterrupted until reaching lips -If they cannot make these sounds, the interarch space, labial fullness, and possible premature contact of rims need to be checked -If not fixed, teeth clicking can be heard during teeth try-in
Labiodental	F, V	55	-V sounds like F → upper anterior teeth are too short -F sounds like V → upper anterior teeth are too long
Linguodental	Th	This, that	-Ideally, 3~6mm of tongue should be visible while saying this -<3mm → max+mand teeth are too buccal ->6mm → max+mand teeth are too lingual
Linguoalveolar	T, D	T, D	-T sounds like D → maxillary teeth are too lingual -D sounds like T → maxillary teeth are too buccal

- Jaw relations

- We want the patient to use their denture with the mandible in centric relation
 - Condyles are articulating at the thinnest avascular portion of the disk, where only a purely rotary movement is possible by the mandible
 - Note: CR and maximum intercuspation coincides in only 10% of the population, which is okay for dentulous people. In edentulous patients, CR and MI should coincide otherwise dentures will contact in odd positions and cause movement
 - CR is a reliable and reproducible position useful when planning occlusion in dentures
 - Good for health, comfort, and function
 - It is the position that jaws normally take during deglutition
 - How to get the patient to bite in CR
 - Make sure there are no interferences by record base (esp in posteriors)
 - Manipulation should cause no pain or stress, or else muscles will tense and deviate the position
 - Deprogramming techniques: swallowing, bite on cotton roll
 - Clinician can also do chin point guidance or bilateral manipulation
 - However in denture patients, CR is best captured by instructing patient to touch the tip of their tongue to the back of their mouth and clinician guiding (not pushing) the jaw closed → works 80% of the time
 - Recording jaw relation
 - Can be done before or after setting up the maxillary 6 anteriors
 - Maxillary rim: place 4 notches, 2 on each side in the posterior region
 - Mandibular rim: take down occlusal plane in the posterior
 - Lubricate maxillary rim with Vaseline
 - Place softened AluWax on mandibular rim. Must be softened
 - Insert record bases into patient's mouth and guide them to bite in CR
 - Allow wax to cool down and capture bite registration
 - Remove from patient's mouth and check for stability → there should be no rotation or rocking



- Limitations of mouth in complete denture occlusion
 - Inability for clinicians to detect subtle changes in motion
 - Hard to make accurate measurements/marks in saliva
 - Inability to know where exactly the condyles are
 - Resiliency of supporting structures
- Transferring to articulator
 - Place AluWax on the bite fork and use it to take a facebow registration
 - Orients the dental cast in the same relationship to the opening axis of the articulator

- Articulators
 - What parameters are considered?
 - Intercondylar distance, condylar inclination, mandibular arc of closure, hinge axis position
 - Why do we use them?
 - Hold opposing casts in a fixed relation. This includes intraborder sliding movements similar to the mouth
 - Mimic opening and closing without having the patient in
 - Planning dental procedures, diagnosing occlusal problems, aid in fabrication of a prosthesis
 - Correct and modify completed restorations
 - What types are there?
 - **Semi adjustable articulator:** accepts facebow, centric jaw relation record, and protrusive records
 - **ARCON:** condylar parts are in the lower frame and condylar guides are part of the upper frame
 - **Non ARCON:** condylar parts are in the upper frame while the guides are on the lower frame
 - Studies have shown that Non ARCON are better for removable dentures and ARCON for PRDP's
 - **Non adjustable articulator:** simple hinge that accepts facebow, centric relation record, and/or protrusive records
 - **Fully adjustable articulator:** accepts facebow, centric relation record, protrusive record, lateral record, and intercondylar distance. Usually needs a pantagraphic tracing or Candiix to set up
 - Limitations
 - Made of metal → not like bone, and also subject to fatigue and wear
 - Subject to human error in tooling
 - Unlikely that articulator will duplicate condylar movements in the TMJ
 - Calibration needed every 7 years
 - Mechanical equivalents or average movements leave a lot to chance and rely on ability to adjust prosthesis
- Using our semi adjustable ARCON articulator – Whip Mix 4000 series
 - Features
 - Positive centric locking, ability to do excursive movements, removal of upper possible
 - 0~70% adjustable condylar inclination
 - 0~25% adjustable progressive side shift
 - Fixed intercondylar distance – 110mm
 - Cross articulation possible → generating same relationship on different articulators
 - Why use semi adjustable articulators for dentures?
 - Greater accuracy, eliminate iatrogenic occlusal interferences
 - Save chairside time with patient
 - Improved lab communication
 - Increase patient's perception of care and skill level
 - Settings to use when we make dentures
 - Incisal guide pin = 0mm
 - Condylar guidance = 25 degrees
 - Progressive side shift = 7 degrees
 - Immediate side shift = n/a
- For the next appointment – order teeth (see instructions in next step)

Denture fabrication step 4 – Teeth selection

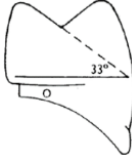
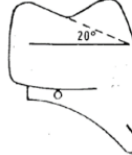
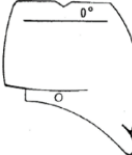
• Teeth material

	Acrylic resin (most common)	Porcelain	Metal
Indications	-Limited intermaxillary space -Opposing natural or gold teeth -Poor ridge condition -Hypersensitive crests -Older patients -Maxillo-facial prosthesis	-Good ridge support -Adequate space -Complete edentulism	
Advantages	-Flexible form, shade, dimensions, function, esthetic, -Easy to grind and polish -Tough -High impact strength -Less abrasive than porcelain -Chemically bonds to prosthetic base -Occlusion easily adjusted	-Resistant to abrasion -Superior esthetics -Can be grinded to obtain desired esthetic -Color stability -Dimensionally stable	-Cast directly on to the frame -Occlusal morphology designed on wax up -Ideal when limited space between ridge and opposing teeth or interproximal small space between 2 natural teeth -Hard -Resistant to abrasion and low abrasiveness -Good impact strength
Disadvantages	-Low abrasion resistance -Wear → loss of OVD -Discoloration -Higher tendency to stain	-Grinding limited (needs polishing if grinded) -Poor bond to denture base -Cannot be used in limited space -Brittle → occasional cracking -Abrasive -Transmits mastication shocks → resorption of ridges	-Difficult to adjust -Hard to polish -Not esthetic

○ Metal insert teeth

- **GPT-8:** Acrylic teeth with metal cutting edges embedded in the occlusal surface
- **Gold overlay:** occlusal surface covered in gold which makes occlusion more durable but unesthetic and cannot be used for anteriors

• Posterior teeth selection

	Anatomic	Semi anatomic	Non anatomic
Description	->30 degree cusps -Fully anatomical long crown forms and long buccal short bite moulds 	-10~20 degree cusps -Semi anatomical (looks like worn teeth), minimal interference 	-0 degree cusps -Non anatomical, with the illusion of worn teeth, no lateral interference 
Indication	-Full dentures -Partial dentures -Combination cases and implant overdentures	-Full dentures when ease of setup and uninterrupted function is desired	-Full dentures -Open occlusal angles permit a lingualized setup with semi or fully anatomical upper posteriors
Ridge type	-Healthy -Minor resorption	-Semi resorbed ridge	-Advanced ridge resorption
Recommended technique	-Bilateral balanced and/or lingualized occlusion	-Bilateral balanced, lingualized, and linear occlusion	-Bilateral balanced, lingualized, and linear occlusion
Advantages	-Natural teeth anatomy → esthetic -In theory, better food penetration -More efficient mastication -Can be articulated for balanced occlusion -Resists rotation -Provides guide for proper jaw closure	-Easy to articulate -Esthetic -Mastication is efficient -Upper lingual cusps form an efficient "cutting knife"	-Easy to articulate and equilibrate -Low lateral forces -Adapts easily to class 2 and class 3 jaw -Adapts to alveolar changes -Relining and rebasing less difficult
Disadvantages	-Hard to articulate -More traumatic -Require a remounting procedure -Relines and rebases are more difficult	-Compromises chewing efficiency, cusp balance, denture stability, and lateral torque -Supports average lateral forces	-Less esthetic -Theoretically does not penetrate food as well and hence less efficient chew -Balanced occlusion harder to obtain

○ Posterior teeth guide

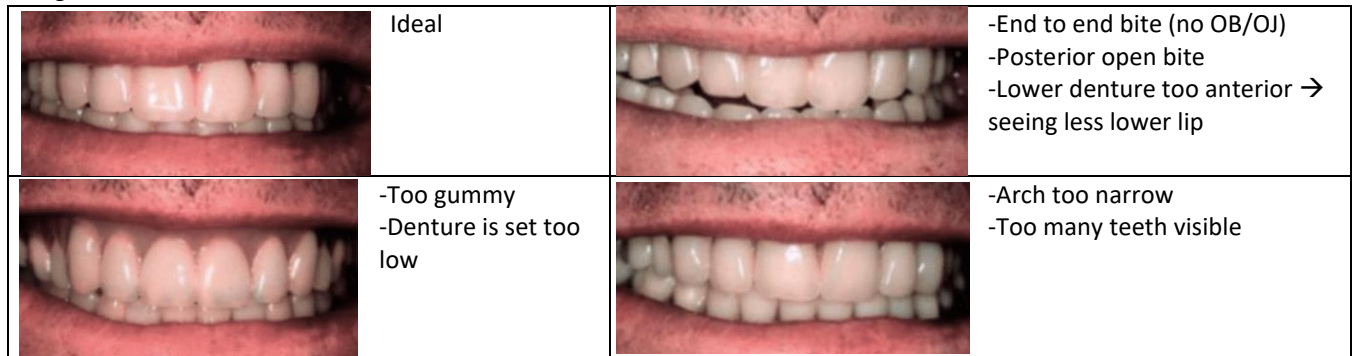
- X = MD length of maxillary premolars and molars Y = MD length of mandibular premolars and molars
- U = buccolingual width of maxillary first molar L = buccolingual width of mandibular first molar
- X is also the first 2 numbers in the teeth set, followed by occlusal height (S, M, L, Ls)
 - Example: "33M" means X = 33mm and teeth at medium height (8.5~10mm)

- Anterior teeth selection
 - How do we know which anterior teeth set to pick?
 - Direct method
 - Pre-extraction pictures
 - See extracted tooth
 - Old radiographs
 - Old casts
 - Indirect method
 - Face shape
 - Width of nose is 4x width of maxillary centrals OR 2 centrals, 2 laterals, 2 half canines
 - Width of face is 16x centrals, 22x laterals, 19x canines, or 3x first molars (?????)
 - **Simple method:** add 8mm to width of nose to get canine to canine distance
 - Gender
 - Male: teeth are larger, squarer, darker, straight smile, might have a diastema, and slight rotation of laterals
 - Female: teeth are smaller, ovoid/tapering, lighter, on a curved arch, and slight rotation or crowding of laterals
 - Age
 - Young: lighter, translucent incisal edge, curved smile, pointy canines, gingiva @ CEJ
 - Old: darker, incisal edge opaque, straight smile, worn edges, gingiva has recession
 - Personality
 - Delicate: tapering and light shade
 - Medium pleasing: ovoid and medium shade
 - Vigorous: square and darker shade
 - At UBC
 - Bring a line from the ala of the nose to the wax rim. Do this for L/R sides
 - Measure the distance between the lines on the wax rim
 - Add 6~8mm
 - Anterior teeth guide
 - First number = facial form

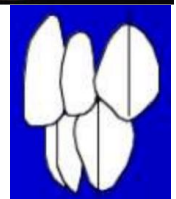
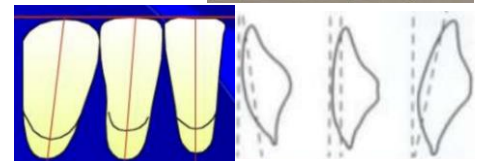
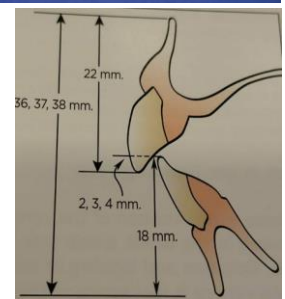
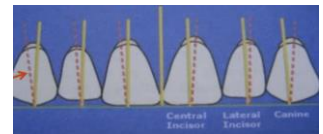
	Square	Ovoid	Tapering
Facial form	-Width of forehead, zygomatic arch, and mandibular angle are equal	-Zygomatic arch is widest -Forehead and mandibular angle are smaller	-Forehead widest and narrows toward chin
Profile	-Straight and flat ala -Sturdy build and masculine	-Ovoid ala area -Build is tender and gentle	-Curved or flat -Ala is almost flat -Build is convex and delicate
Incisal form	-Mesial and distal borders almost parallel on cervical 2/3 of crown	-Mesial and distal borders are curved and buccal surface is rounded	-Incisors narrow going apically -Convex labial surface
 - Second number = profile proportion
 - **Profile shape:** straight, mildly convex, or curved
 - **Profile length:** long, medium, short
 - Letter = width of 6 anteriors
 - A = 40~41.5mm, B = 42~43.5mm, etc
 - Measure width of nose and add 8mm to get this dimension
 - Shade
 - If teeth can be seen before extraction, view teeth in white light, preferably natural light 10AM~2PM and focus on teeth for less than 2 seconds
 - Patient's wishes and personal interests are the most important though
 - Example of ordering teeth on a prescription
 - Maxilla: Please provide 1 x 6 Max anterior portrait IPN in mould 12E and shade P62
 - Mandible: Please provide 1 x 6 Mand anterior portrait IPN in mould N and shade P62
 - Booklets will provide the corresponding mandibular portrait when you pick the maxilla

Denture fabrication step 5 – Setting anterior teeth

- Prior to positioning
 - Ask for pictures and any specific esthetic requests the patient wants in their final denture
 - Note on everything you see
 - May consult patient's SO if they have any specific requests
- Things to look out for



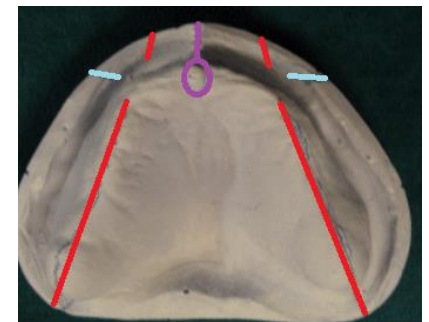
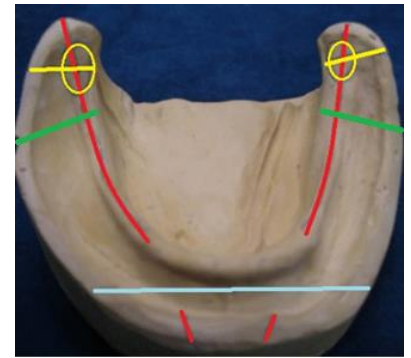
- Steps in setting teeth
 - Mark the midline by having the patient place the wax rim in their mouth
 - Clinician should be directly in front of patient when marking the midline
 - Teeth incisal level
 - Central incisors = at wax rim
 - Laterals = 0.5~1mm above wax rim
 - Canines = at wax rim
 - Maxillary teeth angulation
 - Viewing from the front, the cervical necks are tilted distally/posteriorly. This effect is greatest in the canine
 - Viewing from the side, the teeth tips are facially inclined. This effect is mostly in the laterals, slight in the centrals, and none in the canines
 - Mandibular teeth angulation
 - Viewing from the front, centrals are straight, laterals incline mesially, and canines incline more mesially
 - Viewing from the side, central proclines buccally, lateral is straight, and canine is retroclined
 - Contouring gingiva
 - The height of contour of the gingiva (highest point, yellow line) is always distal to the midline of the tooth (red line)
 - Teeth ordering
 - Can do both centrals, both laterals, then both canines
 - May be easier to perfect one side and then get the other side symmetrical to that
 - Canine placement
 - Maxillary canine tip is distal to mandibular canine cusp tip
 - The offset is 1/2 the width of the tooth



- Ideal denture occlusion
 - Skeletal class 1 patients: 0mm overbite and 2mm overjet
 - Want the anterior maxillary and mandibular teeth to be a slight open bite, and light contacts in protrusion
 - This will definitely feel odd for the patient → takes time to get used to new occlusion
 - Skeletal class 2 patients: 0mm overbite and >2mm overjet
 - This is because class 2 patients habitually move their mandible forward as part of functional movement
 - Must allow for this movement so they feel comfortable protruding their jaw
 - Can tip mandibular incisors up to the vestibule, but apex of the tooth stays on mandibular ridge
 - Skeletal class 3 patients: 0mm overbite and 2mm overjet
 - Mandible has little or no forward functional movement so no overlap needed

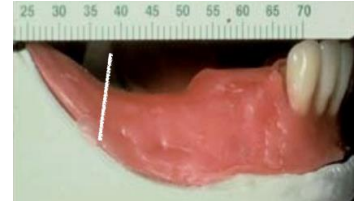
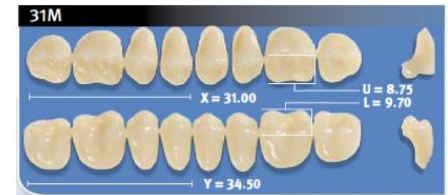
Denture fabrication step 6 – Setting posterior teeth

- Articulator settings (based on average values)
 - Incisal guide pin: 0mm
 - Condylar guidance: 25 degrees
 - Progressive side shift: 7 degrees
 - Immediate side shift: 0
- Draw on casts
 - Mandible
 - Circle the **retromolar pad** and mark a line at $\frac{1}{2}$ height of the pad
 - Vertical height of occlusion will be $\frac{1}{2}$ to $\frac{2}{3}$ height of this pad
 - Identify the height of the **alveolar ridge and extend it** into the vestibule of the cast (anteriorly) and beyond the retromolar pad (posteriorly)
 - Draw a line over the **deepest part of the vestibule** on the anterior jaw – this is as far anterior as the mandibular anterior teeth can tip
 - Draw a line where the **ridge/pad starts to slope** upwards. You cannot place any teeth beyond this line, otherwise the denture will slide forward when the patient bites
 - Maxilla
 - Identify the height of the **alveolar ridge and extend it** into the vestibule of the cast (anteriorly) and beyond the tuberosity (posteriorly)
 - Draw a line indicating the antero-posterior location of the **incisive papilla**. The anterior teeth can go 1cm anterior to this line
 - An alma gauge can be used for this step as well
 - Circle the **incisive papilla** and connect it to the midline
- Selecting teeth
 - Anteriors are selected based on esthetics, but posteriors are selected by functional requirement
 - Posterior teeth come in non anatomic (0 degree cusps), semi anatomic (10~20 deg), or anatomic (30~40 deg)
 - Teeth are available in 0, 10, 20, 33, or 40 degrees
 - How to decide which type of teeth to use
 - Note that anatomic is rarely indicated



What to choose and when?	Anatomic	Non-A
Clenching/Grinding		X
Wandering jaw excursions (Class II, div. 1)		X
Esthetic demands of patient	X	
Habitual eccentric occlusal position		X
Neuromuscular disturbances (ex: Parkinsonism)		X
Denture opposing good natural dentition	X	
Denture opposing worn natural dentition		X
Extreme amount of denture space		X
Good young healthy patients with good ridges	X	
Rapid tissue changes (Immediate dentures)		X
Great horizontal overjet with little vertical overjet (Class II, div 1)		X
Great vertical overjet with little or no horizontal overjet (Class II, div 2)	X	
Flabby soft edentulous ridges		X
Mandibular movements mainly translatory (Class II, div.1 and some Class III)		X
Mandibular movements mainly rotatory (Class II, div.2 and most Class III)	X	
Great discrepancy in size and relationship of the two arches (Cl. II, Div1 and some Cl. III)		X
Patients who have had condylectomy, partial mandibulectomy or repositioning of mdb		X
Treatment or modified old dentures		X
When treating TMJ disturbances		X

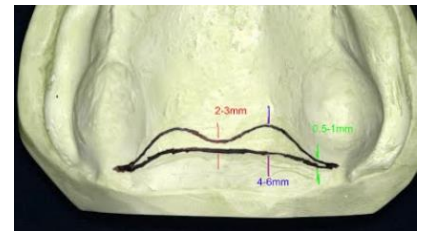
- Teeth size nomenclature
 - Number on tab = width of 4 maxillary posteriors (2 premolars, 2 molars)
 - Letter on tab = occlusal height (S is small, M is medium, L is long)
- Why proper setting is so important
 - Denture acts as a single unit
 - Patient has no proprioception and no periodontium for sensation
 - Bilateral balance is absolutely necessary
 - Incising with complete dentures will affect retention
- Mandibular posterior teeth
 - Teeth should be centered (B-L) over the red line seen in previous page
 - Lingual limit:** lingual cusps aligned with the mylohyoid ridge
 - Placing cusps too far lingually can cause crowding of tongue, tongue biting, and imbalance due to tongue function
 - Posterior limit:** anterior border of the retromolar pad
 - If teeth are placed on the pad, it will be inclined and cause denture to slide forward on occlusion
 - If 4 teeth cannot fit, then take out the first premolar
 - Occlusal limit:** draw a straight line from the canine tip to $\frac{1}{2}$ height of the retromolar pad
- Maxillary posterior teeth
 - Buccal limit:** 1mm more buccal to mandibular teeth
 - Placing too far buccally can cause: cheek biting, esthetic problems, denture instability
 - If mandibular ridge is >8mm wider than maxillary ridge, then teeth need to be in crossbite
 - Posterior limit:** anterior to the tuberosity
 - Placing teeth on tuberosity can cause cheek biting
 - A mandible with 3 posterior teeth can be paired with a maxilla with 4 posterior teeth (esthetics)
- Occlusion
 - Balanced occlusion
 - All posterior teeth and anterior teeth contact in excursions
 - Can be obtained by incorporating a compensating curve (basically Curve of Spee for dentures)
 - Also want a slight Curve of Wilson
 - Lingualized occlusion
 - Maxillary lingual cusps should be in contact with mandibular central fossae
 - Maxilla has anatomic or semi-anatomic teeth while mandible has 0 degree teeth
 - Do not use flat teeth against flat teeth
 - Reduces lateral forces on the ridge and provides an area of closure
 - No maxillary buccal cusp contacts of posterior teeth in centric or lateral excursion
 - Slight contact of anterior teeth in protrusion and laterotrusion
 - Allows good esthetics, function, stability, and simplicity
 - Can be used in all class 1, 2, 3, and crossbite situations
- Which teeth to set
 - Maxilla: anterior 6 teeth
 - Mandible: central incisors only



Denture fabrication step 7 – Wax try-in assessment

- Lab will return wax rim with all teeth mounted
- Assess on articulator
 - Articulator settings intact and received your own articulator back
 - Teeth position, occlusal plane, occlusion
 - Ensure that protrusive/excursive movements aren't blocked by the maxillary molar hitting the mandibular retromolar pad
 - Occlusal plane could be tilted if the patient's ears are uneven




- Assess in patient's mouth
 - OVD, neutral zone, comfort
 - Occlusal plane: retromolar pads, corners of the mouth, fox plane
 - Occlusion: contacts should be same as articulator. If different, mandibular cast must be remounted
 - If patient has whistling while they talk, there is too much OVD
 - Esthetics: only mesial ½ of canines visible on smile
 - Phonetics
 - When patient says "th" sounds, there should be 3~6mm of tongue protruding from upper incisors
 - When patient says "s" sounds, incisal edges should be close, but not touching
- Lastly, have the patient look at it
 - Sign the esthetic approval form prior to sending to lab
- Post-dam preparation
 - Elevated area on the posterior border of a maxillary denture
 - Steps
 - Trace the vibrating line in the patient, using an indelible marker
 - Insert wax try-in to transfer line to record base, then transfer to cast
 - On the cast, use that vibrating line as the posterior border of the post-dam
 - Draw a cupid's bow shape to define the anterior border
 - Instruct lab to carve out this area of the cast, so that the poured acrylic will be elevated here
 - Purpose of a post-dam
 - Retention of maxillary denture
 - Firm contact with palate reduces gag reflex
 - Reduces food accumulation
 - Compensates for shrinkage of acrylic
 - Adds strength across the denture
 - Makes border of denture less conspicuous for tongue



Denture processing


- What is denture processing?
 - Denture base materials are polymerized to form the final denture
 - Conversion of the wax pattern into a resin or other material
- Main material used is polymethylmethacrylate (PMMA, or acrylic)
 - Polymer developed in the 1930's, and is the most common denture base material used today
 - Usually a powder/liquid system
 - Types: conventional heat cured, cold cured, or light activated
 - Advantages
 - Excellent esthetics, adequate strength, low solubility in water, non toxic, easily repaired
 - Can reproduce the wax base fairly accurately and retain details
 - Can be constructed by a simple molding and processing technique
 - Disadvantages
 - Polymerization shrinkage, resulting in distortion of palate and final occlusion
 - 0.2~0.5% linear shrinkage, 6% volumetric shrinkage
 - Unpolymerized methylmethacrylate is an allergen and can irritate the mucosa
 - We use conventional heat cured acrylic
 - **Polymer (powder) contains:** a plasticizer, pigments, opacifiers, dyes, and inorganic particles (glass fiber, glass beads, or zirconium silicate)
 - **Monomer (liquid) contains:** generally pure PMMA with some plasticizer, inhibitor (slows polymerization), and a cross linking agent (resists cracking and crazing)
 - Plasticizers ↑ impact strength, ↓ hardness, proportional limit, elastic modulus, and compressive strength
 - Polymerization: bring heat to 70C → benzoyl peroxide breaks down → initiates long, slow, but complete polymerization reaction

- Another alternative material is nylon
 - Prone to warpage, distortion, discoloration
 - It is harder to polish and prone to bacterial contamination
- Processing techniques of acrylic
 - Compression molding
 - Injection molding
 - Microwave
 - Fluid resin
 - Visible light (↓ stain resistance, ↓ transverse strength, similar shrinkage, poor cohesion to repair additions)
- Compression molding technique

Preparation for flasking	<p>-Wax try-in should be waxed to the final thickness of the denture and all contours properly carved</p> <p>-Wax try-in is placed on the master cast, and the border between the master cast and try-in is sealed with wax</p> <p>-Casts should be soaked in water until all trapped air is expelled (at least 5 minutes). This allows for easier separation later on</p> <p>-Use the pneumatic hammer to delicately separate the cast from the articulator mount</p> <p>-Cast should cleanly separate from the articulator mount, so that a remount is possible</p>	
Flasking	<p>-Use the Hanau ejector type flask, which allows denture removal with minimal risk of breakage</p> <p>-Bottom portion (AKA drag) of the flask is lubricated with Vaseline, along with the cast</p> <p>-The wax-up is not lubricated</p> <p>-Laboratory plaster is placed in the drag</p> <p>-Cast is placed into the lab plaster before it sets</p> <p>-The lab plaster should go up to the land area only, and not “lock in” the cast due to undercuts</p> <p>-Once set, this plaster is smoothed using sandpaper</p> <p>-Then, Vaseline is applied on the lab plaster only</p> <p>-Top half of the flask (AKA cope) is added to the bottom half</p> <p>-Maintain metal-to-metal contact, and trim any plaster preventing this contact</p> <p>-Inside of cope is lubricated with Vaseline</p> <p>-Stone is poured into the cope</p> <p>-All methods should be used to ensure no bubbles</p> <p>-Stone should be poured slightly above the teeth</p> <p>-Just before it sets, remove some stone to expose the tips of the teeth</p> <p>-When the 2nd pour is set, then proceed to the 3rd pour</p> <p>-3rd pour should be slightly above the level of the cope</p> <p>-Place lid on flask and stone should extrude out the holes</p> <p>-Allow investment to set for 35~40 mins</p>	
Boilout	<p>-Entire flask is placed in boiling water for about 6 minutes to soften the wax</p> <p>-You don't want the wax to melt at this stage because it will go into the cast and be hard to remove</p> <p>-Disassemble the flask</p> <p>-Remove the record base</p> <p>-Place under a stream of clean boiling water</p> <p>-Watch to see if any teeth dislodge</p> <p>-Clean the leftover molds with a powdered detergent and then clean one final time with boiling water</p>	

Preparation for packing	<p>Tin foil substitute</p> <ul style="list-style-type: none"> -Acts as a separating medium for the denture from the cast -Applied after the stone is dry, but is still hot -Must <u>not pool</u> and <u>not contact the teeth</u> -Paint the separating medium at least twice -Allow the cast to set to room temperature <p>Mixing the acrylic: Lucitone 199</p> <ul style="list-style-type: none"> -Armamentarium: graduated cylinder, small jar, spatula, cotton tip applicator -21g powder for every 10mL of liquid (3:1 ratio by volume, 2:1 ratio by weight) -Need just enough liquid to coat all the polymer beads in the powder, since having more powder means shorter reaction time and less polymerization shrinkage -Mixing time = 30 seconds, doughing time = 11 minutes, packing time = 30 minutes -Mix in small jar using a spatula -Wait (mix occasionally) until polymer progresses into a doughy texture -Keep lid closed while waiting -The mixture will “snap” when pulled → this is when it’s ready to pack -Doughy stage working time is about 5 minutes <p>Final cleaning of teeth</p> <ul style="list-style-type: none"> -Grab a cotton tip applicator with some monomer on it -Rub on denture teeth to remove any excess tin foil substitute
Packing	<ul style="list-style-type: none"> -Place mixture into the flasks, piece by piece -Acrylic placed in buccal, labial, and palatal/lingual surfaces -Sheet of Densilk (like cling wrap) is wetted then placed between the cope and drag -Assemble flask and place in packing device <p>Trial pack</p> <ul style="list-style-type: none"> -Device will apply 1500psi of pressure to pack the acrylic into the casts -Some acrylic will leak out between the cope and drag (AKA flash) -Open the cope and drag and cut away the excess acrylic using a scalpel -Additional resin can be added in deficient areas -Trial pack 2~3 times, until no more acrylic leaks out <p>Final pack</p> <ul style="list-style-type: none"> -3000 psi of pressure -Should be done without the Densilk plastic sheet -Keep final pack pressed until ready to place flask in a spring clamp <p>Spring clamping</p> <ul style="list-style-type: none"> -After the final pack, the flask is brought from the packing machine to the vice -The vice stretches the springs, so that the flask can fit between the springs -Place flask between springs and wait 30~60 minutes -Remove flask + spring clamp assembly from the vice -The spring clamp closes tightly, but allows resin to expand a little (during processing) and contract a little
Curing	<ul style="list-style-type: none"> -Flask + clamp is placed in an oven for 10 hours -1 hour for preheating, 9 hours at 165F
Deflasking	<ul style="list-style-type: none"> -Flask must cool to room temperature for at least 30 min -Then, immerse in cool water for 15 mins -Premature separation of flask will cause denture distortion -Use a mallet to tap the circle plate under the drag and separate the stone from the drag -Push the circle plate through the cope as well <p>-You will be left with a 3 layered sandwich of stone</p> <p>-Use the pneumatic hammer to separate these layers to expose the newly processed denture</p> <p>-Don’t break the master cast, only remove the plaster that was added during flasking</p> <p>-Most tooth breakage happens during improper deflasking</p>

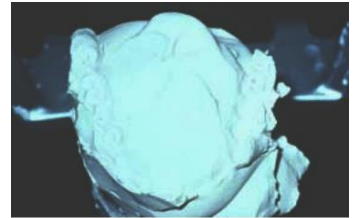


Finishing	<p>Remounting</p> <ul style="list-style-type: none"> -Walnut blast any residual stone on the denture -Retattach the master cast + denture to the articulator mount (use sticky wax) -Incisal guide pin will be out of contact by 0.5~1mm due to processing distortions -Large errors in occlusion should be corrected using selective spot grinding -Minor changes (due to distortion when removing the denture from the cast) can be adjusted clinically <p>Polishing</p> <ul style="list-style-type: none"> -Smooth denture is beneficial to the patient and promotes a healthier oral environment -Series of different grits of pumice and polishing compounds are used <p>Soaking</p> <ul style="list-style-type: none"> -Dentures are soaked in water for 24 hours prior to delivery -This dissolves out most of the remaining unpolymerized monomer -Typically with heat cured dentures, 0.2~0.5% of acrylic is in the form of monomers 	
Characterization	<ul style="list-style-type: none"> -Denture is identified with the patient's name -Can be further characterized for tinting or staining after processing 	

- Errors in flasking
 - Failure to identify and block out undercuts
 - Incorporating air inclusions in the investing stone
 - Forgetting to paint a separating medium on the investing stone
 - Not using tin foil substitute, using contaminated tin foil substitute, or coating the teeth with tin foil substitute
- Errors in packing
 - Too much monomer
 - Not enough resin (i.e. underpacking)
 - Insufficient flask pressure during packing
 - Packing the resin at the wrong stage
 - Failure to bench cure the packed denture prior to curing
 - Failure to achieve metal to metal contact of the flask
 - Packing too early
 - Viscosity is too low for pressure packing
 - Excess monomer may cause porosities in the final denture
 - Packing too late
 - Metal to metal contact on flask difficult to obtain
 - Loss of detail in denture
 - Movement/fracture of teeth or gypsum
 - Increase in VDO
- Errors in deflasking
 - Dentures not adequately cooled
 - Breaking of denture, cast, or both
- Lab prescription
 - Ask for ID tags in both dentures
 - Will be a long prescription
 - Make sure it's organized and in the correct sequence
 - Ask for compression molding technique, give correct temperatures, wait times, etc
 - **Tell lab to soak the casts in water for 5 mins prior to separating mounting jig from the cast**
 - Lab blamed UBC students for not applying Vaseline between mounting and cast
 - Lab said they could not separate without destroying mounting plaster
 - Could not remount
 - However, the lab is wrong because Vaseline is not needed to separate
 - Also, a remounting jig should be made prior to the wax-up being processed (to correct processing errors), and could've been used if they broke the original mounting plaster

Denture delivery

- What do you do if the lab broke the cast
 - Make a remounting base to support the upper denture
 - Then, the denture can rest on this remounting base while a new upper cast is mounted
 - Alginate cannot be used to remount the cast
 - Not border molded
 - Will capture soft tissue in a compressed state
 - May have some twisting in the base if an alginate cast is used
 - Overall, leads to improper mounting
- Why do we need to remount?
 - Lab can remove processing errors
 - Dentist can refine occlusion for the patient
- Inspect dentures
 - ID tags
 - Defects
 - Contours
 - Remount casts
 - Post dam
- Fit and comfort
 - **Maxilla:** support, retention, stability, comfort
 - **Mandible:** stability, comfort, have patient lift tongue
 - Pressure indicating paste
 - Brushed on the inside of the denture to form white streaks
 - High spots will displace this paste and show as a pink area
 - These high spots can be grinded down
 - Thompson stick
 - Used in follow-up appointments
 - Use the stick to mark a sore spot on the soft tissue
 - When the patient wears the denture, the pigment will transfer to the denture
 - Grind this high spot down
- Check both dentures together
 - Occlusion, esthetics, phonetics
 - Intercuspal position should coincide with centric relation position
 - When patient bites down normally, the denture should be in stable occlusion
 - What if there are premature contacts? (ICP \neq CR)
 - Take a new CR record (using heated Aluwax on denture teeth)
 - Verify record
 - Remount casts on articulator
 - Verify mounting
 - Adjust occlusion on articulator
 - Confirm occlusion intraorally
- Post-op instructions
 - Brochure is in the mail room in clinic ("Keeping your mouth healthy and complete dentures comfortable")
 - Will get credit for dentures at the 1 week followup
 - Make sure patient pays prior to receiving the completed dentures
- Follow-up schedule
 - 1 day, 1 week, 2 weeks (prn), then once a year
 - Ask patient to wear dentures as much as possible prior to appointment, so you can see high spots



Denture adjustments

- “My dentures hurt”
 - Use pressure indicating paste and Thompson stick to detect high areas
 - Remove high areas with an acrylic bur
 - Make sure patient has worn prior to appointment, so we can see where the sores are
 - If pain is on the lingual surface of the mandibular anteriors:
 - Lingual flange may be over extended into floor of mouth
 - Protrusive slide: poor denture fit will cause denture to tip when mandible is protruded
 - If pain is on the buccal surface of mandibular anteriors:
 - May present as irritation or even an ulcer
 - Overextension of the flange, pinching on the frenum
 - Lack of anterior overjet causing incisor to incisor contact
 - Excessive anterior overbite
 - Mandibular molars placed on inclined retromolar pad, causing denture to slide and put force on anteriors
 - Improper orientation of occlusal plane, causing dentures to push anteriorly
 - Cheek biting
 - Neutral zone violation
 - Inadequate posterior overjet
 - End to end contact of maxillary and mandibular buccal cusps
- “They make me gag”
 - Loose denture
 - Thick distal border
 - Low occlusal plane (tall maxillary denture) can make it difficult to swallow and trigger gag reflex
 - Teeth too lingual can pinch on the tongue and make it difficult to swallow as well
- “I talk funny with them”
 - Excessive OVD
 - Loose dentures
 - Lack of muscle control by the patient
- “Dentures are loose”
 - Overextended or underextended borders on the final impression
 - Too narrow or too wide border widths
 - Xerostomia (may also be associated with soreness)
 - Tooth position errors
 - Occlusal errors
 - Anatomical limitations
- Adjustments
 - Acrylic should be removed in minimal increments to avoid losing denture stability/retention
 - Patient should have some relief, but adjustments won’t immediately resolve pain. Irritated areas will take a few days to heal
 - Acrylic burs may leave rough surfaces, which will need to be polished
 - This is especially important in the borders
 - Use a wet pumice and wet rag wheel on the bench motor
 - Smaller areas can be polished with rubber acrylic resin polishing points

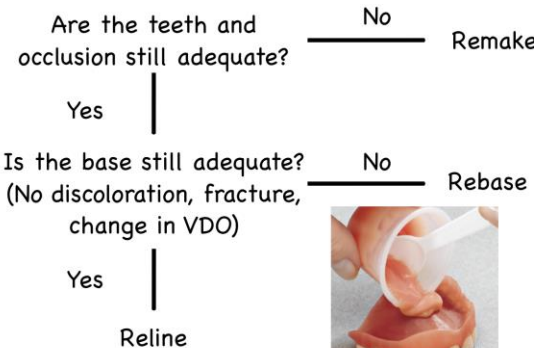


Denture reline, rebase, and repair

- Over time, ridge anatomy can change so the dentist must monitor the patient's soft tissues
- Look for changes in maxillomandibular relationship, decrease in VDO, and TMD
- Goal for reline/rebase/repair
 - Enhance fit (retention, stability, support)
 - Increase VDO
 - Restore appearance
 - Restore occlusion and articulation

Treatments

- Oral hygiene instructions
- Adjustments, repairs
- Reline
 - Resurface the tissue side with new base material, re-establishing accurate adaptation
 - Only the acrylic touching the soft tissues are replaced
- Rebase
 - All pink acrylic is replaced
- Remake
 - Remake denture start to finish



Lab reline/rebase steps

- **Soft (chairside) reline** may be needed to allow tissues to heal
 - Will need the reline kit (Viscogel), a plastic cup, and a steel spatula
 - Mix the powder and liquid to a doughy consistency and place into denture
 - Seat with even pressure and tell patient to bite for 15 minutes
 - Border mold
 - **Ideal result: even 2mm thickness, no bare spots, peripheral roll, and maintained VDO**
 - Trim excess and deliver
 - Offers a quick solution to relining
 - However, has a bad taste, releases monomers (possible allergen), decreased longevity of fit, and tendency to peel and discolour
 - This material is porous, compared to acrylic
- Denture preparation
 - Use acrylic bur to reduce areas in denture
- Impression using the denture as the tray
 - Denture must be border molded prior to impression
 - Use low viscosity impression material
 - Seat the denture by applying even pressure and telling patient to close lightly in CR
 - Hold in light contact for 6 minutes
 - **Ideal result: retentive, stable, even 2mm thickness, no bare spots, peripheral roll, maintained VDO**
- Verify fit, occlusion, and esthetics
- Processing
- Insertion of denture and reassessments
 - After processing, treat like a new denture
 - Insertions and adjustments are done like normal dentures



Denture repair steps

- Index pieces: assemble broken denture piece(s)
- Pour a cast into the denture to hold the fragment in place
- Cut back the acrylic along the fracture line by 2~5mm
- Mix new acrylic resin and place it along the fracture space
- Insert denture and instruct patient to prevent recurrence

- If both dentures need to be relined, then start with the less stable one as it can rest on a stable opposing denture



Immediate dentures

Advantages	Disadvantages
-Maintains esthetics and function – we have a chance to see what the teeth originally looked like -Bypasses the 6 week healing period needed in conventional dentures -More comfort and faster healing of extraction sites -Good adaptation – preserves bone by keeping it in function, slowing resorption of the ridge -Shorter treatment	-More complicated -Final esthetics can't be evaluated prior to fabrication -Retention can be an issue -Needs more maintenance (adjustments, relines, possibly remakes) -More expensive

- Contraindications

- Surgical risk due to medical histories
- Patient doesn't understand the procedure – must understand the meticulous oral hygiene that is required for this process to be a success

- Steps

- Diagnosis and treatment planning
 - Clinical findings and exams indicate that the patient needs a denture
- Disease control and initial extractions
 - Some phase 1 disease control may need to be managed, including extractions
 - Posteriors are extracted first and anteriors are spared, so patient can keep their smile
- Impressions
 - Custom tray is made in edentulous areas
 - Custom tray is border molded and used to take a PVS impression
 - Then, an alginate “pickup” impression is taken while the custom tray still in place in the patient's mouth
 - The alginate will just take the impression of the teeth
 - Pour this PVS + alginate hybrid impression with stone
 - The cast is then used to make a record base with wax rim (avoiding teeth areas)
- Jaw relation record
 - Aluwax is added to this rim and bite registration is taken
 - Casts can now be mounted in occlusion on the articulator
 - Ideally, you will preserve the OVD based on the level of the remaining teeth, but there are cases where OVD will need to be increased
 - If increasing OVD, then add wax on the occlusal surface of the wax rim
- Wax try-in
 - Teeth are mounted in the areas with wax rims
 - Follow all principles of teeth setting, like the overjet and occlusal relationships
 - Confirm if OVD is where you want it
- Surgerize the master cast
 - Remove the teeth from the casts
 - Recommended that this is done by the student/dentist, NOT the lab. The lab will drill a hole right into the tooth to form a socket, which will cause the immediate denture to have extra material by the socket and require much more adjustments
 - Remove teeth to form a smooth ridge continuous with adjacent alveolus
- Denture fabrication
 - Once surgerized by the student/dentist, the cast is sent to the lab and the lab mounts the remaining teeth and flasks the assembly to make the final denture



- Surgical guide fabrication
 - Lab will also take an alginate impression of the surgerized cast and use it to make a surgical guide
 - It is a transparent base which is pressed into tissues after extraction
- Extractions and insertion of denture
 - After extractions, insert the surgical guide and press into the arch
 - High spots in the guide will blanch the tissue
 - If this is due to a bone spicule, then remove that sharp piece of bone (Rongeur/drill)
 - Otherwise, adjust the denture with an acrylic bur
 - High spots will blanch the tissue, indicating bone needs to be drilled down in these areas or the denture needs to be drilled
 - Organize a ride for the patient if they will be taking stress relieving medications
 - Give post extraction instructions to the driver, as patient may forget while being on meds
- Reassessment
 - Day after extractions
 - Clean denture
 - Check sockets
 - Adjust denture base (may be hard to differentiate extraction erythema vs sore spot erythema)
 - Tissue swelling will make the denture tight initially, but will loosen in a week → let patient know
 - Remount and adjust occlusion of dentures
 - Reinforce denture hygiene
 - 1 week after
 - Remove sutures (if not yet resorbed)
- Reline
 - Re-evaluate 1x/month for at least 3 months
 - Viscogel is preferred over Cosoft are viable for chairside relines
 - About Cosoft
 - Harder → not good for new extraction sockets, usually used for obturators
 - Chemically inhibits bonding of heat processed acrylic later on

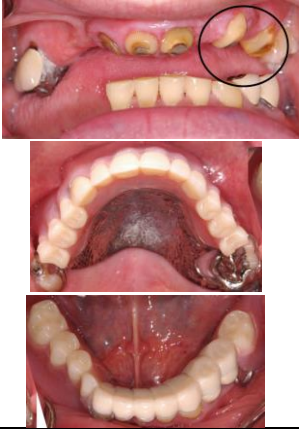
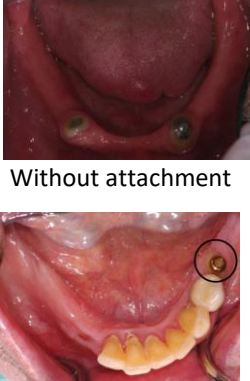
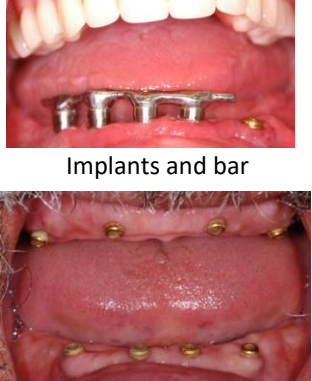


Overdentures

- Removable partial denture that rests on natural teeth, roots of natural teeth, or dental implants
 - Improves oral function and comfort
 - **Indications:** stained/malformed teeth, partial anodontia, dentinogenesis imperfecta, amelogenesis imperfecta, severe erosion or abrasion
 - **Contraindications:** enough tooth support to make a fixed or removable partial prosthesis, poor oral hygiene (if considering natural tooth structure overdentures)

Advantages	Disadvantages
-Preserve alveolar bone -Preserve proprioception -Retention -Patient acceptance, better psychological impact Compared to a fixed prosthesis -Decreased cost -Easier access for hygiene -Better support, esthetics, phonetics Compared to a complete denture -Increased masticatory ability (complete dentures = 59%, overdentures = 79%)	-Additional treatment time -More technique sensitive -More expensive than complete dentures -Increased maintenance and recall procedures -Retained teeth can develop caries or have periodontal issues

- Types of overdenture abutments

Teeth	Roots	Implants
	 <p>Without attachment</p> <p>With attachment</p>	 <p>Implants and bar</p> <p>Implant single attachments</p>
<p>-Minimal tooth preparations</p> <p>-Denture goes over the incisal edges of all the teeth</p> <p>-In areas like the lower mandibular teeth, may be a little unesthetic</p> <p>-Tell patient about these esthetic limitations and upper/lower colours may not match prior to starting</p>	<p>-For teeth that were too weak to be supporting a partial denture</p> <p>-Crown is shaved down, improving the crown:root ratio</p> <p>-Root canal is done on the root then filled with composite</p> <p>-No attachment: shave stump round</p> <p>-Attachment: drill in attachment assembly after RCT + composite</p>	<p>-Single attachments: cheaper and easier to clean. However, they require all implants to be parallel to each other. Will need 2~4 implants</p> <p>-Bars: use if surgical implants are not parallel to each other</p>

- Root overdentures – treatment steps

- Diagnosis and treatment planning
- Disease control and abutment selection
 - Consider: bilateral abutments, location, angulation, C:R ratio, periodontal health, caries, endodontics
- Endodontics and extractions
- Impressions, jaw relation record, and wax try-in
- Overdenture fabrication (+ surgerize master cast if this is an immediate overdenture)
- Insert and deliver overdenture
- Reassessment
 - Monitor for caries, gingivitis, periodontitis, and trauma
- Maintenance
 - Oral hygiene, fluoride, CHX, abutment teeth scaling, denture relining
 - Patient can load fluoride into denture and wear it → prevent abutments from getting caries

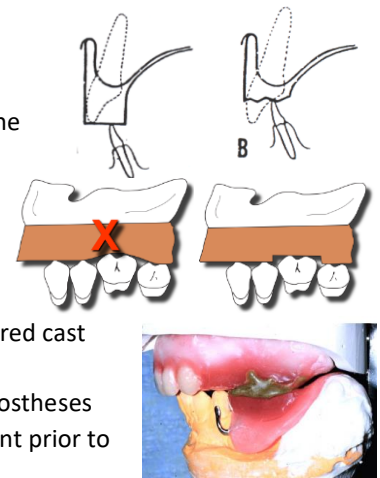
- Implant overdentures – treatment steps

- Diagnosis and treatment planning
- Implant placement and healing
- Uncover implants and abutment selection
 - Abutments can be a ball on the implant and a socket on the denture
 - Abutment can be a bar spanning 2 implants, with the denture clipping into this bar (called a **Hader bar**)
 - Ball + socket attachments are better if implants aren't parallel
- Impressions, jaw relation record, and wax try-in
 - Plaster is used to take an impression of the abutment positions
 - PVS is flexible and will not hold the attachments in place
- Overdenture fabrication
- Insert overdenture
- Maintenance
 - Ensure patient knows how to take dentures in/out themselves
 - Patient should brush gently around abutments
 - Diluted bleach will disintegrate attachments, mouthwash will stiffen and make attachments brittle

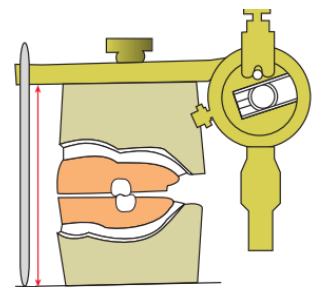


Single dentures (setting a denture on natural teeth)

- Background
 - Maxillary single dentures are more common
 - Maxillary teeth is lost before mandibular teeth, as bone is stronger in the mandible and mandibular teeth have less roots than maxillary
 - Maxillary single dentures should be avoided if there are only mandibular anterior teeth
 - Will lead to **combination syndrome**
 - **Main symptoms:** resorption of maxilla, overgrowth of tuberosities, papillary hyperplasia on palate, extrusion of lower anteriors, and loss of denture under partial denture bases
 - **Other symptoms:** loss of VDO, occlusal plane discrepancy, anterior spatial repositioning of the mandible, poor adaptation of the prosthesis, epulis fissuratum, periodontal changes
 - **Pathophysiology:** migration of occlusal plane due to maxillary bone loss and enlargement of fibrous tuberosities due to loading in a non-physiologic angle. Mandibular anteriors also start to migrate
 - **Prevention:** fabricate a PRDP for the mandible, to distribute bite force
 - Mandibular single dentures should generally be avoided
 - Mandible has less denture supportable tissues and thinner mucosa+periosteum
 - Will result in severe ridge resorption of the mandible due to excessive forces
 - Stress reduction methods like an overdenture or implant retained denture should be used, OR all the maxillary teeth should be extracted, for overall better long term oral health
 - Mandibular single denture has some rare indications
 - Class 3 jaw relationship (mandible is larger than normal, or maxilla is smaller than normal)
 - Patient has a cleft palate (maxilla will exert less stress on mandible)
 - Patient has mandibular reconstruction due to trauma or cancer
- Difficulties with single dentures
 - Heavy occlusal forces due to opposing natural teeth
 - Denture foundation can't resist high occlusal forces → bone loss of alveolar ridge
 - Supraeruption of opposing teeth → unharmonious occlusal plane and reduced vertical space to fit a denture
 - Mesial drift of opposing teeth → unharmonious occlusal plane
 - Increased likelihood of denture displacement or fracture
- Steps
 - Diagnosis and treatment planning
 - Natural teeth: tipping, extrusions, abrasions, wear surfaces, crossbite relationships
 - Malpositions make it difficult to balance the denture
 - Impressions
 - Wax rims and jaw relation record
 - Less based on facial landmarks like ala-tragus line, but more based on the opposing occlusion
 - Maxillary anterior wax rim should be made thin on the lingual surface, so that the mandibular anteriors can have some overlap
 - If mandibular teeth have an uneven occlusal plane, create **steps** in the wax rim, **not inclines**
 - If the mandible needs a PRDP, then fabricate the occlusal rim (after altered cast step) and adapt it to the wax rim of the maxillary denture
 - If the mandible needs a crown or FPD, may have to order these fixed prostheses to be waxed up on the master cast so that they can be tried in the patient prior to fabrication
 - Wax try-in
 - **Anteriors:** want to bring the anterior teeth out of occlusion, but also not create an excessive overbite. There is a compromise between acceptable esthetics and proper function
 - **Posteriors:** typically lower posteriors will be supra-erupted, so adjustments to teeth position will be needed to get stable centric contacts. Denture teeth will not normally articulate well with natural dentition. Watch out for inclines, rotated teeth, etc
 - If the lower jaw has a crown/FPD in progress, it should be waxed up in this stage and articulated



- Natural teeth occlusal adjustment and/or wax-up of FPD
 - Indications
 - Used to reduce severe curve of Spee
 - Level out supraeruptions
 - Recontour rotated teeth so that contacts are on a flat surface
 - Gross malpositions can be dealt with by extraction or orthodontic repositioning
 - Steps
 - Assess the occlusal plane, and how the teeth need to be fixed to obtain this occlusal plane
 - Practice on a cast prior to see feasibility prior to working on patient
- Denture fabrication
 - Mostly as usual, if using acrylic. However, a cast metal denture is also an option
 - Cast metal denture is indicated when there are repeated denture fractures or if there is very limited space in a strong patient
- Insertion of denture
- Reassessment
 - Let patient know that they need to maintain OH in the leftover teeth
 - This includes regular cleanings
- Other fabrication tips and advice
 - Tip for mounting posterior teeth on articulator
 - Increase incisal pin by 1mm → set posterior teeth → return pin to original position → adjust occlusion until pin touches table
 - This prevents the denture tooth from having a pinpoint contact against the natural tooth
 - Much easier to do this on an articulator than in the patient
 - Denture teeth wear
 - Acrylic teeth will wear quicker when opposed to natural teeth
 - Will require more frequent recalls
 - Adjust occlusion to prevent changes in stress distribution
 - Never use porcelain teeth as it will cause severe attrition of opposing teeth
 - Denture fractures
 - Dentures can fracture from: heavy forces from natural teeth, occlusal contacts on inclines, impingement on a bone midline, or flexing of the denture
 - Can be fixed by flattening the contacts
 - Could also switch the denture to a cast metal base




Implant overdentures

- Overdenture
 - Complete or partial denture that rests on natural teeth, roots, or implants
 - By maintaining a few roots or using implants, it improves function of the resulting denture
- Implant overdentures

Advantages	Disadvantages
-Preserves alveolar bone and provides a static stable base -Jaw records are more accurate, improving occlusion -Reduce trauma to the soft supporting tissues -↑↑ retention and stability compared to mandibular complete denture -↑ masticatory efficiency -Patient acceptance and psychological impact -Reduce/eliminate denture flanges -Requires fewer implants and less critical positioning compared to fixed prostheses on implants -↓ cost compared to fixed prosthesis -Ease of oral hygiene	-Additional treatment time -More technique sensitive -More expensive than conventional dentures -Increase maintenance and recall procedures -Require adequate interarch space (12mm of space between the crest of bone and occlusal plane)

- Indications
 - Advanced ridge resorption
 - High muscle attachments complicating CD fabrication
 - Patient preference of a removable prosthesis over a fixed one
 - Trauma with large hard/soft tissue deficiency
 - Congenital or developmental defects
 - Parafunction
 - Nerve impingement
 - Lack of vestibular and lingual depth
 - Gagging
- Performance
 - Compared to complete dentures, there was a 300% improvement in the maximum occlusal force
- Steps
 - Diagnosis, treatment planning, patient consent
 - Patient expresses need for implant support, as they are unsatisfied with conventional dentures
 - Patient understands finances, risks, benefits
 - Patient is healthy enough to undergo surgery and has adequate bone volume and quality
 - Types of implant-to-denture design

Implants with an attachment	Implants with a bar
-Preferred if the ridge shape makes a bar too difficult -Parallelism of implants is more critical	-If 3+ implants, can also have a distal cantilever -Bar needs to be: 2mm+ away from soft tissues, round in cross section, and parallel to occlusal plane -Clip on denture should be perpendicular to axis of prosthesis rotation -Only used when an attachment is not feasible
O ring + ball attachments Hader bar and clips Locator attachments	

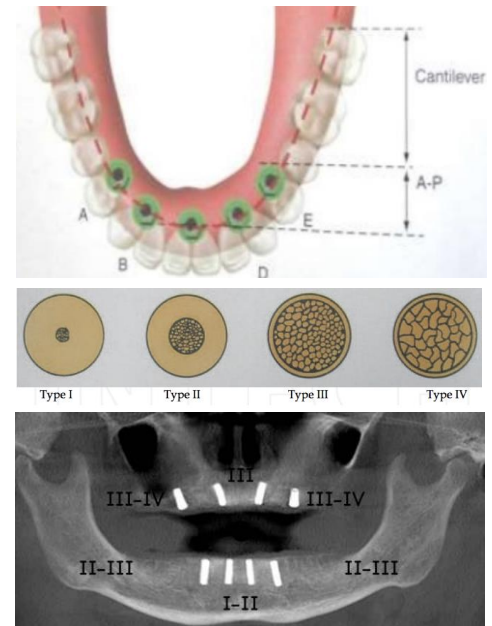
- Radiographic guide and surgical guide
 - Will be covered in next lecture
- Implant placement and healing
 - Tissues are reflected to expose bone, where implants are drilled into place
 - Tissues are sutured back closed, with implants not being seen
 - Healing can take 2~3 months in a healthy patient and depends on quality of bone, type of implant, and initial stability of the implant at placement
- Uncover implants and abutment selection
 - Open the gingiva to access the implants
 - Place the healing abutments then suture the gingiva closed again
 - Allow time for gingiva to heal before proceeding with prosthesis
 - 4 weeks healing in complete edentulous pts, posterior fixed prosthetics
 - 8 weeks healing in anterior fixed prosthetics + another 6 months with a temporary crown
 - Types of abutments/attachments

O ring + ball attachment	Hader bar and clip	Locator attachment
-Overall height 4mm, 5mm minimum height -0.4mm resiliency -Used for rotation, resilience, and fixation -Easy to use and low cost -Different degrees of retention -Wide range of movement -Ball end attaches to implant, and cannot be unscrewed once placed. Not replaceable	-Minimum 5mm long bar -Greatest bulk is 1.9mm -Smallest clip is 3mm long -20 degree clip rotation -3 different retention strengths	-Total attachment height of 3.17mm -Comes in straight and extended range males -Comes in different colors and retention

- Impressions, jaw relation record, and wax try-in – see overdenture lecture
- Overdenture fabrication
- Insert overdenture
- Maintenance – see overdenture lecture

Implant guides for overdentures

- Site selection
 - Bone height thicker than 10~12mm
 - Be weary of pathologies like cysts, infections, and bone resorption
 - Know location of anatomic structures like the sinus and nerves
 - Quality of the bone
 - Location of adequate bone
- Contraindications
 - CV conditions: recent MI, valvular prosthesis
 - Severe renal disorder, treatment resistant diabetes, severe hormone deficiency
 - Chronic and severe alcoholism, drug addiction, heavy smoker
 - Generalized secondary osteoporosis
 - Radiotherapy >4000 cGy
- AP spread
 - Measure the distance between the center of the most anterior implant to the distal of the most posterior implant
 - The amount of cantilever should not extend 1.5x this distance
- Quality of the bone
 - Type I: homogenous cortical bone
 - Type II: thick cortical bone with marrow cavity
 - Type III: thin cortical bone with dense trabecular bone of good strength
 - Type IV: very thin cortical bone with low density trabecular bone of poor strength
 - Best bone is type II – it has good cortical bone for primary stability and good blood flow for healing
- Radiographs required

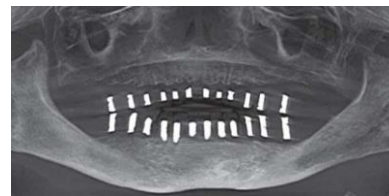
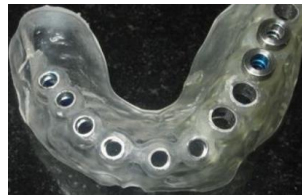
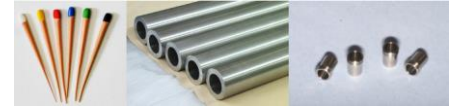


	Periapical	Panorex	Cephalogram	CT scan
Uses		-Visualize anatomical structures -Easily available -Low cost	-Evaluate thickness and vertical height of bone in midline -Easily available -Mid-cost -In reality, very rarely used for implant screening	-Can view bone and anatomic structured in 3d -Less than 2% distortion -High cost and high radiation
Radiation		25%	14%	2%
Distortion		6.7 uSv	1.7 uSv	314 uSv
1 implant	PA + occlusal	Yes		
2~7 implants	PA + occlusal	Yes		?
8 implants	PA	Yes		Yes

- However, radiographic guidelines above are recommendations from the American Academy of OMFR
- Realistically, radiographs should be taken as follows:
 - No suspected resorption: one implant = PA, multiple implants = PA and Pan
 - Posterior implants close to IAN or sinus = CT scan
- Radiographic guide for pan or PA
 - Patient wears a device that contains a metal tube or gutta percha of known length
 - The metal tube/GP allow us to exactly measure the amount of bone available for an implant when taking PA's or panoramics
 - These markers are embedded into clear acrylic resins or drilled directly into their old denture if the patient is planning to discard the old denture
- Radiographic guide for CT scan
 - Traditionally, the radiographic guide is worn by the patient during the CT scan
 - Nowadays, patient is given a CT without a guide, then a guide scanned by the lab is superimposed into the CT

- Radiographic guide fabrication

- Examine existing denture
 - Wax up missing teeth or wax up a whole denture if there is no previous denture
 - Wax up teeth if the positions on the old denture are not adequate
 - Reline old unstable denture if needed
- Duplicate denture in clear acrylic
 - Take a cast and repour the denture into clear acrylic resin
 - If patient doesn't care about discarding the old denture, the guide can be made directly on to it
- Prepare guide for implants
 - Use the implant lab kit drills to drill where the implant is planned to be
 - Fill the implant sites with gutta percha or with prefabricated metal tubes
- Have patient wear the guide and take the radiograph



- Surgical guide fabrication

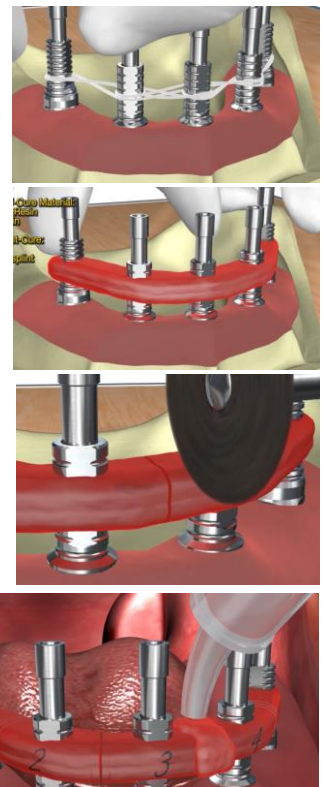
- Surgical guide: guides the surgeon on proper implant placement (B-L, M-D, G-I)
- Remove GP in the radiographic guide
 - Gives space to drill in metal guides to make the surgical guide
 - If you used metal tubes to begin with, then you are already ready for surgery

- Nobel guide fabrication

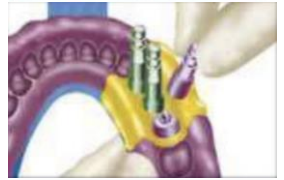
- Diagnosis and treatment planning
- Diagnostic teeth setup/wax or duplicate existing denture
- Fabricate a radiographic guide as instructed above
- Digitize and 3D treatment planning
 - Take a CT scan on the patient
 - Then, take a CT scan of just the radiographic guide
 - Use computer modelling to define implant positions
 - Allows better treatment communication to the patient, as they can visualize and grasp a better understanding of the treatment to be done
- Guided surgery using the surgical guide

Impression for implant overdentures

- This whole lecture can be summarized in a 10 minute video:
 - <https://www.youtube.com/watch?v=Tc-RI22xu3E>
- 2 impression techniques
 - Indirect (closed tray transfer technique)
 - Usually less accurate since implants cannot be connected together
 - Needs a patient with wide mouth opening as they need to clear the implant copings as well as the thickness of the impression
 - Can be used as a preliminary implant impression using a stock tray
 - Can be used to fabricate a transfer jig for the final impression
 - Direct (open tray pick-up technique)
- Indirect technique steps
 - Remove healing abutments and place and screw in the impression copings
 - Do this one implant at a time, don't remove all abutments at once
 - If the implant-coping junction is subgingival → take a radiograph to ensure no space between the implant coping and everything is seated properly
 - If the implant-coping junction is supragingival → use a non-abrading explorer to check for full seating
 - Block out hex holes
 - Verify fit of the impression tray over the copings
 - Take the impression by applying light body around implants and medium body in tray
 - Remove impression from mouth
 - Remove impression copings and seat back healing abutments
 - Reinsert impression copings into the impression in the proper orientation
 - Pour soft tissue into the implant area in impression tray
 - Then, finish off impression by pouring the rest with stone
- Direct technique steps
 - Make a transfer jig at least 24h before impression
 - Transfer jig is a material that ensures implants are in the correct position on the impression
 - Without a transfer jig, likelihood of having perfectly positioned implant impressions are close to 0
 - How it's made:
 - Start by making an indirect impression cast
 - Criss cross non-waxed floss around implants on the cast
 - Apply resin around all floss
 - Wait 24 hours for resin to set
 - Section up resin with a disk, as resin will have contracted due to polymer shrinkage
 - Label each section with a number
 - If you provide the lab with an indirect technique impression, they can fabricate the transfer jig, section it, and send it back
 - Re-lute/re-attach the sectioned transfer jig pieces
 - Done when the implant copings are screwed back into the patient's mouth
 - This large piece with the implant coping + resin is now the "transfer jig"
 - In a patient with limited opening
 - Entire transfer jig can be made directly in the mouth
 - Downside is that it will be less accurate
 - One screw test
 - Verify seating of the transfer jig in the patient
 - Screw in only one implant on the transfer jig
 - All other implants should still be fully seated and not lifted
 - Repeat this by screwing in each implant alone
 - If it fails the one screw test, section the jig and re-lute



- Prepare the custom tray
 - Based on a cast from the indirect method or from a preliminary alginate impression cast
 - Custom tray is made as usual, but holes are drilled out where the implants are
 - You can cover the window with some base plate wax so that PVS doesn't go everywhere while you are trying to load the tray
 - Verify screw and tray clearance prior to loading material and taking impression
- Take a full arch impression
 - Make sure the screws are visible and exposed before the material sets, so that you can unscrew the copings when taking the impression out
 - Unscrew the retaining screws and remove the tray, which will have the transfer jig embedded in it
- Attach implant analogs to the copings inside the impression
- Pour part of the impression with soft tissue material
- Pour rest of the impression in working cast material



- Fabricate base plates for normal denture fabrication
 - With no attachments
 - Used if attachments will be picked up at chairside after the overdentures are processed
 - Wax is added on the top of these abutments to create some space in the base plate
 - With attachments
 - Used if attachments will be processed the same time as the overdenture
 - Temporary abutments are screwed into the implant sites to get an estimate of where the implant attachments will be
 - More accurate
 - **Don't use impression copings** since they cannot be modified or grinded down at all. If they are grinded down, there is no way to unscrew it
 - Temporary abutments have the screw at the bottom (it's a hollow tube), so the abutment can be grinded down to appropriate height without worrying



Implant overdenture complications

- Possible issues
 - Poor denture and oral hygiene
 - Food debris can accumulate under implant
 - Can also present with calculus and inflammation around implants
 - Buildup can also accumulate on denture, compromising fit and comfort
 - Peri-implantitis and bone loss may be seen
 - Tissue hyperplasia
 - Denture movement causes inflammation and tissue hyperplasia
 - Explain to patient that adjustments should be made when fit is poor, to avoid these issues
 - Poorer hygiene related due to inflammation can worsen inflammation
 - Attachment wear
 - Silicone part of attachments will change colour, indicating how worn down they are
 - Replacement is every 3~12 months, and patient will need to pay for this
 - Abutment wear
 - Regular recalls are necessary to monitor if attachments or bars are weakening
 - Poor retention
 - Poor angulation of implants
 - High soft tissue attachments
 - Gingiva could grow into attachment area and impinge on assembly
 - Attachment lengthening or gingivoplasty may be needed
 - Food debris in attachments
 - Denture teeth wear
 - Fracture of denture base
 - Due to high forces of occlusion, and high concentration of forces around the implant
 - Pieces can be glued back and sent to the lab to be repaired
 - Fracture around attachment housing
 - Due to acrylic being too thin
 - Loosening of abutments
 - Abutment/bar fracture
 - Screw fracture
 - Bone loss
 - Seen in ~50% of implant patients
 - Implant loss
 - If peri-implantitis is severe and prolonged, implant loses support
- Maintenance protocol
 - Recommended inspection and cleaning at least once every 6 months
 - Patients at high risk (age, dexterity, med Hx) should have an exam more frequently
 - Biological maintenance
 - Oral hygiene instructions and hygiene around implants
 - Hygiene for prosthesis
 - Mechanical maintenance
 - Detailed exam of prosthesis and prosthetic components
 - Adjust, repair, replace, remake any parts
 - At home maintenance
 - Brush implants and bar with a soft brush at least 2x/day
 - Clean overdenture with a denture brush and denture cleaning agent at least 2x/day
 - Remove overdenture while sleeping
 - Store overdenture in a cleaning solution

Attachments for overdentures

- Attachment selection criteria
 - Available bone
 - Patient's expectations
 - Studs are easier to clean and have better retention
 - Financial ability to cover costs
 - Bars are more expensive due to additional procedures and difficulty in impression taking
 - Personal choice and clinical expertise of the dentist
 - Experience and technical knowledge from the lab
- Types

	Attachment	About	Advantages	Disadvantages
Stud attachments - <u>Extra radicular</u> : male component on implant - <u>Intra radicular</u> : male component forms part of denture base and engages a specially produced depression within the root contour	Ball (O-ring, Dalbo)	-Doughnut shaped gasket on denture attaches to a ball or undercut on the implant Parts: - <u>Metal encapsulator</u> : undercut region that houses the gasket - <u>Ball post</u> : has a head, neck, and body. The head is wider than the neck - <u>O-ring</u> : 3 sizes, made of flexible nitrile and fluorocarbon	-Ease of changing attachment -Wide range of movement, can bend and return to approx. original shape -Low cost -Different degrees of retention, if implants are not all parallel -Possible elimination of time and cost of superstructure	-Hard to change ball
	ERA	-Primitive form of locators		
	Locators (most commonly used)	-Made of nylon -Profile height 2.5mm (shortest of all) -Diameter 4.1mm -Angle corrections of up to 40 degrees	-Universal hinge -Resilient attachments -Can correct implant angulation differences of up to 40 degrees	
	Magnets		-For limited dexterity -Easy to clean	-High maintenance -Thin layer of acrylic holding magnet in denture breaks off
Bar attachments	Dolder bar	-Egg shaped bar in cross section -Open sided sleeve -3.5x1.6mm or 3.0x2.2mm -Has a spacer	-Spacer allows some degree of movement	-Spacer means less support
	Hader bar	-Bar is cast from prefab plastic pattern -Bar has a resin/plastic sleeve -No space -3mm for bar, 2mm for clip and housing	-No spacer means more support -Prefab plastic pattern → no need for soldering -Precise, simple, versatile -Rigid splint -Good retention, stability, and support -Cross arch stabilization -Positioned close to alveolar bone (less leverage)	-No spacer means less flexibility -Bar is bulky -Plaque accumulation -Wearing of bar -Soldering procedure -Manual dexterity needed

- Attachment resiliency
 - Rigid non resilient attachments: screw retained hybrid overdenture
 - Restricted vertical resilient attachments: prosthesis can move up and down with no lateral, tipping, or rotary movement
 - Hinge resilient attachments: resists lateral tipping, rotational and skidding forces (e.g. Hader bar)
 - Combination resilient attachments: unrestricted vertical and hinge movements (e.g. Dolder bar joint)
 - Rotary resilient attachments: prosthesis can provide hinge and rotary movements
 - Universal resilient attachments: provides vertical, hinge, translation, and rotational movements (e.g. magnetic)

- Fabrication of the attachment into the denture
 - Start with a locator-implant cast
 - Lab technique
 - Take jaw relation, do wax-up, and try-in as per normal denture
 - When sent to the lab to make the final denture, the lab has extra processing steps
 - Lab places white ring, black processing male cap and locator cap into the implants on the cast
 - Then, the lab processes the denture above this cast
 - Chairside technique
 - Remove healing abutment on the patient's implants
 - Seat locator abutments (pic #1)
 - Hand tighten to 20 Ncm torque (#2)
 - Block out the abutment by placing a white block-out ring (#3)
 - Place housing over the abutment (#4)
 - Create space in the overdenture to accommodate the attachment
 - Use an acrylic bur to drill out under the overdenture (#5)
 - Use pressure indicating paste and indelible marker to check for high spots on the attachment (#6)
 - Clean site with alcohol
 - Apply bonding agent on the cavity made for the attachment in the overdenture
 - Dry the patient's implant housing assembly
 - Load bonding material into the overdenture and the implant housing (#7a, #7b)
 - Place overdenture in patient's mouth and let it set (light cure PRN)
 - Remove denture and inspect for voids
 - Final cure
 - Remove black processing male attachment (#8a) in the overdenture and replace with the definitive retentive male piece (#8b)
 - Final result (#8c)



• Tools

