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Approval & Review Process Initiated by Neil Heath, T Owens
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Filename Imaging Referral Criteria for Newcastle Dental Hospital
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Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	1 of 16

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Imaging Referral Criteria for Newcastle Dental Hospital

These criteria have been put in place to ensure that justification and/or authorisation of all ionising radiation examinations referred to Dental Radiology is carried out. Justification (or authorisation under protocol) is mandatory for all referrals under the Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME)R 2017). Justification of an exposure will be carried out by an entitled IR(ME)R practitioner (Consultant Radiologist for Dental and Maxillofacial Radiology referrals) or authorised under protocol by an operator (Specialist Dental Radiographer).

The aim of this is to offer guidance and assistance to clinical staff when requesting Dental and Maxillofacial Radiology imaging at the Newcastle Dental Hospital.

These criteria have been updated to reflect revisions to radio-sensitivity *weighting factors* for sensitive organs exposed during a range of standard head and neck imaging techniques. The addition of ionising imaging techniques, such as cone beam CT, demand rigorous justification criteria to keep dose levels to the absolute minimum.

The Dental and Maxillofacial Radiology Department at Newcastle Dental Hospital currently has one consultant Dental and Maxillofacial Radiologist who will on occasion modify requests (with reference to the referring clinician if required) in order that patient safety is ensured. In his absence the Supt/Senior Radiographer on duty may liaise with the referring clinician to perform this role.

1. Referral Criteria

- General Guidance

For much of the clinical problem solving in dentistry, intra-oral radiography is still of value.

Intra-oral radiography.

- Modified Palmer notation method or modification stated here-is the current accepted method of tooth notation at NDH e.g. UR6: upper right first molar
- Clarity in tooth nomenclature is essential - Be aware, `L` if written may look like the sign for upper left quadrant.
- Periapical radiographic requests should be specific so the radiographer can minimise dose *e.g. a request for periapicals of UR 2 – UR 4 region will mean the patient having x3 radiographs when the main area of interest may be the canine. There must be a specific clinical reason for the examination listed on all requests*

Panoramic Radiography (DPT – Dental Panoramic Technique)

The digital panoramic systems at NDH allow a number of programmes which permit dose reduction and minimise distortion of dental tissues.

A default protocol which will cover the smallest field possible will be followed by the radiographer unless justification (clinical information) is given to support the use of a larger field.

*TMJ imaging should now not routinely be carried out using the panoramic imaging modality-----see **TMJ imaging page 11.***

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	2 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Guidance by Clinical Condition

Caries.....	4
Endodontics.....	4
Maxillo, odontogenic and non-odontogenic pathology.....	5
Foreign Bodies.....	6
Radiology check list - query inhalation foreign body	6
Periodontal Assessment.....	7
Dental Anomaly.....	8
Dental Trauma.....	8
Orthodontics Dental Development Assessment for Paediatric Patients.....	10
Dental Extractions.....	11
Unaccounted Tooth or Tooth Fragments at Extraction.....	11
Advice on the preferred action as a result of loss of dental instrumentation or material during treatment	12
Impacted Teeth.....	12
Maxillofacial Fractures.....	13
Temporomandibular Joint Imaging.....	13
Soft Tissue Swellings in Head and Neck.....	14
Salivary Gland Imaging.....	14
Dacrocystography.....	15
Pre surgical implant and Craniofacial Imaging CBCT.....	15
References.....	16

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	3 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Caries

Bitewing Radiography (BWR)

BWR is still the best imaging modality to assess inter-proximal caries. In addition, a further advantage this technique offers is the ability to image crestal alveolar bone with minimal distortion.

- Sites of known carious disease should be recorded
- Bitewings are not recommended at intervals of less than 6 months
- Consider bitewings in the preschool child if assessed as high caries risk
- Reassessment of caries risk status of the patient should occur prior to any subsequent radiograph as below :

Caries Risk	Imaging Interval Guidance
High	6 Months
Moderate	12 Months
Low (Primary Dentition)	12-18 Months
Low (Permanent Dentition)	24 Months +

Caries Risk (Eapd 2004 Approach)	Imaging Interval Guidance	
	High Risk	Low Risk
5 Years	12 Months	3 Years
8-9 Years	12 Months	3- 4 Years
12 – 16 Years	12 Months	2 Years
16 Years	12 Months	3 Years

Caries Risk (SDCEP 2018 Approach)	Image Interval Guidance
Children at increased risk of developing caries	6-12 months
All other children deciduous dentition	12-18 months
All other children permanent dentition	2 yearly
If there is a valid reason not to take radiographs as specified above e.g. well-spaced dentition where posterior contacts are examinable and no other caries is visible in the mouth; ensure this is documented in the patient's notes	

SDCEP: 2018 Prevention and management of dental caries in children: 2018

Endodontics

Periapical Pathology

A periapical view can be obtained to assess periapical pathology where it may be suspected, for example, in the heavily restored tooth and where signs and symptoms are present.

Root Canal Therapy

A periapical view should be obtained prior to commencement of root canal treatment, assessment of working length, completion of root canal treatment and at any other time that clinical signs and symptoms require better understanding in the course of root canal therapy. In the absence of symptoms, further follow-up radiograph should be taken at one year after completion of treatment (This may be in the GDP follow-up remit). Persistent or recurrent signs and symptoms may justify radiographic review earlier than 12 months. For lesions that show signs of no or limited healing after 1 year annual radiographs may be justified for up to 4 years before a final decision is made or any further future course of treatment.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	4 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Root Canal Perforations and Fractured Teeth.

A periapical(s) occasionally at different angles can be taken of the tooth in question in the first instance. The initial image should be reviewed prior to proceeding further.

Endodontic techniques such as selective/serial caries excavation, pulp capping and pulpotomy in permanent teeth may have bespoke radiographic requirements that will be advised by the specialist endodontic team.

CBCT and Endo- small volume cone beam CT capability is now available to allow high resolution (HR) studies to look for root fractures and `missed `canals.

Indication for the use of small volume CBCT can include:

- ✓ Detection of radiographic signs of periapical pathosis when the signs and/or symptoms are non-specific and plain film imaging is inconclusive;
- ✓ Assessment and/or management of dento-alveolar trauma, which may not be fully appreciated with conventional radiographs;
- ✓ Appreciation of anatomically complex root canal systems **prior** to endodontic management (e.g dens invaginatus);
- ✓ Nonsurgical re- treatment of cases with possible untreated canals and/or previous treatment complications (e.g. perforations);
- ✓ Assessment and/or management of root resorption, which clinically appears to be potentially amenable to treatment;
- ✓ Presurgical assessment prior to complex periradicular surgery (e.g. large periapical lesions in posterior teeth, and the evaluation of their proximity to adjacent relevant anatomical structures);
- ✓ Identification of the spatial location of extensively obliterated canals, also taking into account the possibilities of guided endodontics;
- ✓ Detection of periradicular bone (secondary) changes indicative of root fractures, when clinical examination and conventional imaging modalities are not conclusive

Root morphology may not require HR scanning only a standard setting to reduce dose. NB- If obturating material or canal dressing material is in the root canal- this may set up such artefacts(beam hardening/streak) that makes CBCT scanning for these cases, non- justifiable. (Even with artefact reduction algorithms). Please discuss with DMF Radiologist.

Consideration of `deconstructing the coronal metallic restoration` in order to reduce artefact at the time of scanning should be a prerequisite to CBCT requesting in the endodontic case.

Maxillofacial, Odontogenic and Non Odontogenic pathology

Refer for specialist investigation if suspected.

If the three dimensional nature of a neoplasm requires assessment then CBCT can be requested- this will be vetted by the duty radiologist. Discussion is always welcomed if there are any questions about the best modality to utilise.

If the history is suggestive of a systemic disease especially malignancy, then conventional medical/ multi-detector imaging (e.g.MDCT/MRI) with intravenous contrast may be indicated to include areas of the body in addition to the head and neck. Such a situation may necessitate a supplementary panoramic radiograph as part of the baseline assessment.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	5 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

If the lesion is suspected to be odontogenic, and hard tissue centred, with the possibility of soft tissue involvement being unlikely, cone beam CT imaging may be indicated.

CBCT has the potential to utilise CAD-CAM technology in order to produce 3D resin models, after discussion with the radiologist. (This is currently carried out in Cardiff- request via Supplies in specific cases – liaise with radiologist).

Masses in the hard palate can invite a request for CBCT with the additional request that a wax wafer be used to hold down the tongue during acquisition. This allows air contrast against the palatal mucosa to make the effacing lesion's extent, easier to appreciate.

Similarly, gingival masses can invite a CBCT request with the additional use of cotton wool rolls in the buccal or labial mucosa to reflect the soft tissues and create an air interface with the lesion. Please state this on the request form.

(The use of occlusal radiography or conventional facial radiographs to assess the third dimension is usually of little benefit if a cone beam CT can be conducted).

Foreign Bodies

Where the presence of a foreign body is suspected refer for specialist investigation.

The following series of simple checks must be carried out prior to requesting radiological evaluation for suspected foreign body inhalation.

Radiology check list-query inhalation foreign body	
Check oral cavity /sulci	
Check- throat pack/ any swabs	
Check gowns	
Check floor	
Check suction contents(if appropriate)	
Re check teeth charting(pre op)	
If lost` foreign body` not found and suspected in aerodigestive tract, please contact	Radiology secretaries at RVI Main X ray dept. (28) 20243 Liz Barrons (Radiologist Secretary) Or (28) 39810 Reporting radiographer These phones are manned between 0830- 1700hr weekdays.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	6 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Request an urgent chest X ray (CXR)	Forms available on dental dept or electronic referral to main Xray dept..
Reporting Radiologists (RVI) - Dr Beattie -Dr Muller	(28) 29610 (28) 31141
Reporting radiographer (Chest)	(28) 39810
Out of hours registrar	(28) 29621

Foreign bodies (FBs) can be imaged depending on their composition and location.

Where possible, the likelihood of radiopacity should be known e.g. most glass is radiopaque due to the high atomic number of its constituents. Wood is often of such low density that can be missed on CT. If `wood` is suspected then the radiologist should be informed.

Ultrasound imaging may offer a useful `first line` investigation of FB as it can describe location, give depth measurement and relationship to significant anatomy, e.g. blood vessels. Radiology-assisted ultrasound-guided retrieval of superficial FB can also be offered. There may be scope for this upon discussion with the Consultant Radiologist (+/-Intraoperative if required).

If radiography is required then the location of the material will be important.

In relation to teeth consider:

- FB in the lips - periapicals with soft tissue lateral lip projection (low KVp setting)
- FB in the maxillofacial region - consider cone beam CT

N.B. early discussion with the radiologist is recommended as FBs may track along tissue planes and end up in sites remote from the entry point. Entry point should be communicated on the request form - Samples of the FB material are always appreciated in planning imaging if they are available at the time.

Periodontal Assessment

General Points

The decision on how to image the periodontium should be made with reference to localised or generalised disease. Clinical information regarding proportion of loss of attachment as well as other complicating factors will help guide imaging technique selection.

BWR (horizontal) can be utilised in periodontal assessment if the pocketing is uniform and <6mm.

BWR (vertical) is an underutilised technique which takes advantage of a beam which will approach the cervico-enamel junction at 90 degrees so minimising distortion. Probing depths >6mm, if localised, will have bone loss and this may be demonstrated using this technique (This technique should be discussed on a case-by-case basis with the Radiographers).

Localised periodontal breakdown will often best be demonstrated on **selected periapical views**. This allows for an assessment to be made of the proportion of root support that is affected, as well as giving an indication of root morphology and periapical disease. This can be especially useful in heavily restored teeth.

If the disease process is **advanced and generalised** a referral for a Dental panoramic tomogram (DPT) is indicated. A move away from full mouth periapicals will be the approach wherever possible. The periodontium can be demonstrated with minimal horizontal tooth overlap and minimal vertical foreshortening (especially in the upper arch) on newer DPT equipment- (Orthogonal program). If not available selected additional periapicals can be given to supplement.

The referrer should state the modality and the teeth e.g. BWR or periapical or DPT.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	7 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Every effort should be made to establish if a patient has had dental radiographs within the last six months, and if so, obtain them.

Radiography of the dento-alveolar structures should be considered in the following situations:-

1. Pain, swelling or purulent discharge.
2. Pocket depths greater than 4mm for single-rooted teeth or 3mm for multi-rooted teeth.
3. If a furcation lesion is suspected or diagnosed clinically.
4. Suspicion of combined periodontal/endodontic disease, "perio-endo" lesion.
5. If the treatment plan is dependent upon the integrity of a heavily restored tooth.
6. Teeth with subgingival restorations.
7. Carious teeth.
8. Mobile teeth.

CBCT and Perio- CBCT is not indicated as a routine method of imaging periodontal bone support. However, to see multirrooted teeth prior to periodontal surgery, - selected cases may benefit from CBCT. These cases must be discussed with a Radiologist prior to requesting e.g. pre-periodontal surgical planning the repair of periodontal defects so that the bony walls of the defects can be assessed.

CBCT may be useful in selected cases where there is isolated refractory disease to allow `root form` to be appreciated- e.g. grooves in roots. (small Vol CBCT ideally).

NB- Metallic restorations will degrade the ability to see the periodontium due to artefact and so this must be assessed at time of CBCT request.

Further it is not `dose efficient` to have multiple small volume CBCT scans in separate quadrants- discuss with radiologist if any queries.

Much of the above is coincident with the 'FGDP selection criteria for dental radiography 3rd edition.'

There is an update from the 'BSP: Good practitioners guide to periodontology 2016', saying similar to the above but includes radiographs being necessary for codes 3 and 4, and the gold standard is a periapical to calculate bone loss and clinical attachment loss.

DPT should only be considered if there are a variety of dental concerns.

Dental Anomaly

Radiographs (periapical, occlusal, DPT) may be indicated when the clinical examination reveals a suspicion of a dental abnormality. Use of a combination of an occlusal or second periapical radiograph can locate un-erupted teeth by parallax (discussion around suitability of CBCT 3D imaging on a case by case basis can be offered.)

1. Unusual eruption patterns
2. Delayed eruption
3. Unexplained missing teeth
4. Unusual morphology

Dental Trauma

Radiographs of

- Anterior teeth – a periapical view(s) should be obtained. (Paralleling technique) if tolerated in the first instance.
- Posterior teeth-periapical view(s) if this can be tolerated.

After the initial periapical images have been obtained and evaluated, if no tooth fracture is seen, consider:

Upper or Lower Anterior Occlusal: This is very useful for detecting root fractures by allowing the central ray to approach the tooth at a steeper angle. It is also useful, as an initial assessment in small children who may be very distressed at the time of trauma.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	8 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Soft tissue views (reduced KVp setting): Where there is a suspicion of unaccounted tooth/teeth or tooth/teeth fragments in the soft tissues.

In the case of displaced teeth/fragments then lateral cervical spine, chest or abdomen XR referrals can be made to the main Radiology department at the RVI (local sedation /OS GA theatre protocols will be made available to guide on site in an emergency).

Where additional injuries are suspected, for example fractured mandible or tuberosity, or intra-oral views are not possible due to presenting symptoms, refer for CBCT can be considered.

Permanent Dentition Trauma

Enamel Fracture. A periapical radiograph should be taken at the initial time of presentation and at subsequent visits if clinical signs are abnormal.

Enamel/Dentine Fracture. A periapical radiograph can be taken at the time of initial presentation and at 3, 6, 12 months and 2 years.

Enamel/Dentine Fractures involving the Pulp.

Pulp cap: A periapical radiograph should be taken at the time of initial presentation, 3 months, 1 and 2 years and at any time clinical signs and symptoms are abnormal.

Cervical Pulpotomy and Partial Pulpotomy. A periapical radiograph should be taken at 3, 6, 12, 18 months and at additional times as per signs and symptoms.

Mature Pulpectomy. A periapical radiograph should be taken at the initial presentation, calculating the corrected working length, directly after obturation, at 6 and/or 12 months, and at any time clinical signs and symptoms are abnormal.

Immature Pulpectomy

A periapical radiograph should be taken at the initial presentation, calculating the corrected working length, at change of dressings (every 3-6months), immediately after obturation, at 12 months, at 24 months and at any other times that clinical signs and symptoms are abnormal.

Crown/Root Fracture

A periapical radiograph should be taken at the time of initial presentation, at 6 months, 12 months +/- 18 months and at any time clinical signs and symptoms are abnormal.

Crown/Root/Pulp Fracture

A periapical radiograph should be taken at the time of initial presentation, during pulpotomy, pulpectomy, apexification and GP root filling procedures, at 6 months, at 12 months +/- 18 months and at any time clinical signs and symptoms are abnormal.

Root Fracture

Root fractures can be classified as coronal/gingival third, middle third and apical third. A periapical radiograph should be taken at the time of initial presentation, at 3, 6 weeks, 3, 6 months, yearly reviews and at any time clinical signs and symptoms are abnormal.

Concussion

A periapical radiograph should be taken at the time of initial presentation, 6 months, at yearly reviews and if at any time clinical signs and symptoms are abnormal.

Extrusion/Lateral Luxation

A periapical radiograph should be taken at the time of initial presentation, at 2-3 weeks to check for marginal bone breakdown, at reviews (3, 6, 12, 24 months) and at any time clinical signs and symptoms are abnormal.

Intrusion

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	9 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

A periapical radiograph should be taken at the time of initial presentation, at reviews (1, 2, 3, 6, 12, 18, 24 months) and if at any time clinical signs and symptoms are abnormal.

Avulsion/Re-implantation

A periapical radiograph should be taken at the time of initial presentation, at review times (7-10 days, 1, 2, 3, 6, 12, 24 months) and if at any time clinical signs and symptoms are abnormal.

Dentoalveolar Fractures

A periapical radiograph should be taken at the time of initial presentation, at 1 week, 1, 3, 6 months, yearly and at any time clinical signs and symptoms are abnormal.

Primary Dentition

Radiographs can be of use in diagnosing the possibility of disruption of the permanent tooth follicle. Taking an anterior occlusal radiograph with the tube in the midline allows right and left comparison of the incisors and follicles.

Enamel/Dentine Fractures

Radiograph at time of initial presentation and at any time clinical signs are abnormal.

Lateral Luxation

Radiograph at time of initial presentation, 3 months and at any time clinical signs are abnormal.

Intrusions

Radiograph at time of initial presentation, at 3 months and at any time clinical signs are abnormal.

Cone beam CT can yield information regarding the extent of tooth fractures in 3D to facilitate treatment planning. (Looking for root fractures in `obturated teeth` can reduce the sensitivity of CBCT assessment due to artefact. Discussion with the radiology department necessary.

Protocols for radiographers to authorise urgent examinations for this situation have been agreed in the event of a radiologist not being available to directly justify the examination.

Orthodontics: Dental Development Assessment for Paediatric Patients
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The assessment of the developing dentition at around 12 -13 years may justify a referral for a DPT of the dentition only (no condyles). In addition, a DPT can be requested prior to orthodontic treatment unless other useful imaging has already taken place that shows root length and shape.

A suspicion of abnormal development may merit a referral for a DPT or alternatively referral for specialist treatment.

If at this stage supernumerary teeth are noted on the DPT, the IR(ME)R practitioner will assess and decided the most effective imaging required for further assessment and/or investigation.

A DPT can be justified for assessment/treatment planning of the dentition in which there is clinical evidence of widespread caries/pathology, especially if treatment under a general anaesthesia is a possibility or is required.

Cone beam CT

Large volume CBCT should not be used routinely for orthodontic diagnosis. Research is needed to define robust guidance on clinical selection for large volume CBCT in orthodontics, based upon quantification of benefit to patient outcome. However, if the location of un-erupted or supernumerary teeth are in question, or if there is suspicion of adjacent tooth resorption, then a cone beam CT may be indicated. If an initial periapical is available then further conventional views may not be required.

It would not be best practice to take a series of conventional or parallax views to then have to take a cone beam CT. With the advent of `small volume CBCT - low dose settings` the gross position of an ectopic tooth can be visualised, and this can now be used for assessment here at NDH. An exception to this is when the justification for 3D CBCT imaging, is to assess resorption of an adjacent root in which case a standard dose setting is required to record detail.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	10 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

N.B. The timing of any cone beam CT imaging should be optimised- only if active intervention is about to be undertaken will the radiation dose be justified and be shown to yield optimum benefit.

Cone beam CT will help assess cleft palate patients both pre and post operatively. If autologous grafting is being planned using a donor graft site in the mandible, this must be communicated on the request. In addition- if the soft tissues of the nose are relevant then this must be communicated so the radiographer who will position the patient optimally in the FOV. Cotton wool rolls can be placed in the buccal sulcus next to a cleft to show air against soft tissue defect if requested.

Lateral cephalometric analyses are not routinely indicated.

Patients with significant skeletal discrepancy with imminent surgical or orthodontic planning may justify a lateral cephalometric radiograph (CEPH).

If orthognathic surgery is being planned using a cone beam CT (large field), the lateral cephalogram equivalent can be generated from the extended field of view data. *No supplementary lateral CEPH is indicated in such a situation.*

CBCT may replace the need for Multi Detector CT in some circumstances.

CBCT is not normally indicated for planning the placement of temporary anchorage devices in orthodontics

Dental Extractions

It is justified to take a pre-extraction periapical radiograph in the following cases:

1. History of previous difficult extractions
2. A clinical suspicion of unusual anatomy
3. A medical history placing the patient at special risk if complications were encountered
4. Prior to orthodontic extractions
5. Extraction of teeth/roots that are impacted, buried or likely to have a close relationship to anatomical structures (e.g. mental/inferior dental nerve, the maxillary antrum and /or tuberosity and the lower border of the mandible)
6. If complications were encountered during what was considered a "routine" extraction

Unaccounted Tooth or Tooth Fragments at Extraction

If there is the real possibility of a tooth or a fragment entering the airway then the patient should be referred immediately for soft tissue cervical spine and chest radiography. This is most likely if the patient has lost the cough reflex in a sedation setting or at GA.(see above table p5 of 14 section foreign bodies).

Onward transfer of the patient to the Accident and Emergency Department at the Royal Victoria Infirmary (RVI) with a letter of referral is appropriate where urgent treatment is required. Patients < 16 years old should attend children's department at the RVI.

In the maxillary arch, where teeth are definitely lost in the antrum, then a **maxillary oblique occlusal radiograph** may be considered. If surgical intervention is planned and the exact location of a displaced root is required, then a cone beam CT assessment (FOV to include the full naso-maxillary complex up to the nasion) near to time of surgery may be indicated.

N.B. conventional radiographs cannot confirm or refute an oro-antral communication.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	11 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Ultrasound imaging may offer a useful 'first line' investigation of FB if it is thought to be in the soft tissues, as it can describe location, give depth measurement and relationship to significant anatomy, e.g. blood vessels. Radiology-led ultrasound-guided retrieval of superficial FB can also be offered.

Advice on the preferred action as a result of loss of dental instrumentation or material during treatment

- 1 Where there is loss of dental instrumentation or material with symptoms suggestive of inhalation, there is a clear indication for referring the patient for further medical assessment which might include chest imaging and bronchoscopy.
- 2 Where dental instrumentation or material may have been swallowed the risk to the patient is likely to be minimal unless the inhaled foreign body is thought to be very sharp, with a risk of perforation of the gastro intestinal tract.
- 3 Some text books and clinicians suggest that when there is loss of a dental instrument or material, the patient should be referred for chest x-ray, even when no symptoms of inhaled foreign body have occurred. It is recognised that inhalation of most large foreign body objects would give rise to immediate symptoms which would therefore require immediate treatment and further clinical intervention as indicated. However it is also recognised that occasionally small objects may be inhaled without causing symptoms at the time of inhalation. Such small objects might subsequently be expectorated, but there is a potential risk that they could give rise to late complications. The potential risk of such late complications arising must be balanced against the risks which could arise from investigating all patients in whom dental instruments and material has not been accounted for. We are not aware of good definitive evidence upon which to base decisions in this area.

Given the above overview the action to be taken is detailed below:

- a) Where an item of dental equipment or material has been lost during treatment the Dentist should undertake a risk assessment of the situation including a search for the missing item and questioning of the patient about any sensation of having inhaled the item (e.g. coughing, spluttering). **Please see the checklist on PAGE 5.**
- b) Where the patient has experienced symptoms suggestive of inhalation the patient should be referred for medical assessment with a view to considering the need for chest imaging and bronchoscopy.
- c) Inhalation of small foreign bodies may not necessarily cause immediate symptoms. Sometimes such material may be subsequently expectorated, but there is a small risk that such inhaled items could give rise to subsequent respiratory complications. Under these circumstances the dental practitioner should consider referring the patient for a postero anterior and lateral chest x-ray. Not all foreign bodies will be visible on chest x-ray. Advice from a medical Radiologist may be prudent in these circumstances (see contact numbers in table on p5/6 above). The patient should also be advised of the situation, indicating that some dental material has not been accounted for. The patient should be advised to report any subsequent respiratory symptoms to the Dental Practitioner and General Medical Practitioner, and further investigations such as chest imaging and bronchoscopy may be indicated under those circumstances.

Impacted Teeth

Only patients who have undergone clinical assessment where impacted teeth are suspected of causing symptoms will merit imaging, for example, for the number and morphology of roots, relationship to neurovascular canals, early resorption of adjacent teeth or where there is accompanying odontogenic pathology. In these cases a referral for a half DPT or DPT is justified with the choice of view depending on signs and symptoms being either unilateral or bilateral.

There is no justification for radiography of third molars to determine the presence of, or screen for pathology related to, un-erupted molars. (SIGN Guidelines 2000.) Guideline removed Feb 2015 No Update. In the absence of an update this imaging department still works to this guideline.

Author	Owner	Revision	Active Date	Review date	Page
MCC / NH	NH	2.2	04/02/2021	02/2023	12 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Imaging of impacted teeth, where the number and morphology of roots, relationship to neurovascular canals, early resorption of adjacent teeth or where accompanying odontogenic pathology is requiring assessment will justify a CBCT.

(Vertical and horizontal parallax views are in the main redundant techniques. They may be required in patients who are unable to tolerate cone beam CT imaging for any reason).

Maxillofacial fractures

Fractures involving the mid third of face and mandible should have had full assessment by a suitably qualified clinician to rule out other synchronous significant injuries- e.g. cervical spine.

The dental and maxillofacial radiology department no longer has a skull unit and so clinically assessed patients with suspected facial fractures, can have urgent cone-beam CT(after discussion with the dept.).

The ability to image OM (occipitomenal) and PA mandible views is now not possible with loss of the skull unit from this department. If these are considered the imaging of choice the referral to the main X ray dept RVI will be necessary. All relevant previous imaging should be available to the radiology dept when booking the cone beam CT to allow justification.

Where possible an immediate radiology report will be made by the duty radiologist and appropriately communicated. Images will go immediately to PACS.

N.B. Often maxillofacial fractures occur synchronously with base of skull and dento-alveolar fractures. These are often not appreciated on conventional facial views. Cone beam imaging allows only the anterior 2/3 of skull base to be captured in the same field of view. CBCT is not the modality to assess head injury.

In some circumstances CBCT may prevent conventional medical CT having to be undertaken for the maxillofacial region.

If the patient is unable to tolerate cone beam CT imaging, referral in the RVI will be arranged for radiological assessment. (A referral protocol for this situation is in place).

Temporomandibular Joint Imaging

Radiographs often do not add information because most Temporomandibular joint disorders are due to soft tissue dysfunction rather than bony changes (which appear late and are often absent in the acute phase). MRI is the investigation of choice to identify internal joint derangements. A new HASTE sequence allowing dynamic assessment is now available and reported on by the Cons DMF Radiologist. Pls bear in mind that these dedicated MRI TMJ sequences may not exclude central lesions in the base of skull and brain- these will require separate requests.

US scans can offer a `half way house` between clinical examination and MRI of the TMJs. US can show a `joint effusion`, condylar travel and condylar erosion to be identified but is operator-dependent. If the degree of condylar mobility is to be assessed, then an ultrasound examination can be requested where actual measurements of condylar translatory movement can be provided. This negates the need for conventional open and closed views. Masseter muscle hypertrophy can also be assessed.

If hard tissue pathology, secondary to degenerative changes in the joints is suspected- where **crepitis** is evident or **surgical intervention is being planned**, then a CBCT or MRI Scan should be arranged. Cone beam CT is a radiation

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	13 of 16
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dose-effective alternative to assess bony changes in the TMJs. Pls request a Cons DMF Radiology opinion for all CBCT TMJs.

If a local mass or TM disc position and soft tissue joint derangement problems are best assessed using MRI. If teeth require appreciation with hard tissue TMJ imaging- then discussion with the radiology dept. will help. *The usefulness of conventional `open and closed` sectional panoramic radiography of condyles, (with relatively large coverage of the radiosensitive parotid glands), and other historical conventional views, are now questionable given recent advances in imaging. If in doubt about image justification pls liaise with the Cons DMF Radiologist.*

Soft Tissue swellings in the head and neck

Ultrasound imaging is usually the best first line imaging in this clinical setting.

Size, location, depth, vascularity and compressibility can all be assessed on ultrasound. Deep lesions/masses will require CT or MRI referral.

US guided FNA service is currently available at the NDH. US guided core biopsy for suspected lymphoma should be directed to the Freeman Hospital X ray dept.

Salivary Gland Imaging

All salivary imaging will be vetted and appointed to the most appropriate modality. MRI sialography in some cases may be the investigation of choice especially in these days of Covid risk.

CBCT sialography is not routinely undertaken due to dose considerations and the fact that beam hardening and streak artefact from the contrast agent degrade images .

All conventional sialograms will have an US scan to exclude masses.

Often ultrasound will be the first line investigation to exclude a suspected salivary gland mass.

Known or potential obstructive salivary gland disease (stones, ductal strictures or ductal effacement) can invite a request for Sialography from a secondary care setting only. Patients who cannot tolerate conventional sialography, or who at consent, opt out of this investigation, can usually be offered MR Sialography.

Contra indications to carrying out conventional sialography include

- contrast agent hypersensitivity
- acute infection in the salivary gland
- patient choice to have MRI sialogram

Parotid sialographic conventional study will involve ultrasound imaging, a `control` sectional panoramic, a `contrast` sectional panoramic and a `post evac` sectional panoramic.

These views may be altered by the radiologist on the day.

Submandibular sialographic conventional study involves ultrasound, control sectional panoramic (+/-) lower true occlusal, contrast sectional panoramic and a post evac sectional panoramic.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	14 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Patients who require multiple gland investigations, those with suspected masses that extend into the deeper tissues, or patients with known contrast allergy, should be referred for MRI sialography, with appropriate imaging referral and `safety checklist` completed.

Dacrocystography

Dacrocystography, using cone beam CT and contrast media introduced into the nasolacrimal duct, is a current innovation at the dental hospital.

Head position in the CBCT scanner is as for an under tilted Occipito – Mental facial radiograph, so that the nasolacrimal duct is perpendicular to the floor.

Patients with longstanding histories of obstructive nasolacrimal disease and epiphoria can be imaged using this modality (discuss with the DMF radiologist).

Pre and post-surgical implant assessment and craniofacial imaging-Cone beam CT

Pre surgical planning –Implants.

Imaging of the jaws to assess the quality and quantity of bone prior to implant placements is possible using CBCT. The suitability of craniofacial donor sites for graft harvesting can be assessed for bone characteristics and for neurovascular surgical hazards with CBCT.

If bone grafts/ ridge augmentation has occurred and there is a `time sensitive window` to place the implants- please make the radiology department aware of this as it will affect vetting urgency.

Pre agreed protocols to allow the scanning of guidance splints is in place.

If a splint is required to be scanned in situ **this should be clearly stated on the Radiology request form.**

Scans should not be booked too far in advance. Anything after 3 months in the future should be discussed with the Radiologist.

Inclusion on the CBCT request as to where the implants might be placed will help focus the radiology report. The report will scrutinise for bone morphology, presence of surgical hazards and potential foci of infection.

Post-surgical implant assessment

- A baseline radiograph at time of implant loading after the completion of the initial adaptive bone remodelling phase
- after the first year in function
- subsequent radiological investigations should be dictated by individual clinical parameters.

Pre orthognathic surgical planning using cone beam CT

The standard protocol for surgery involving the mid face and mandible which will allow soft tissue profiling will require an agreed protocol for CBCT. This service has yet to be fully developed to utilise CBCT at NDH.

Pre and post op orbital floor fracture repair CBCT – can be offered to limit eye dose and image in an upright posture.

Where it is likely that evaluation of soft tissues will be required as part of the patient`s radiological assessment, the appropriate initial imaging should be MDCT or MRI, rather than CBCT.

Post operative imaging at 3 months is currently agreed.

Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	15 of 16
This document is uncontrolled when printed. Check Revision BEFORE use!					

Many of the protocols suggested above e.g. use of cone beam CT may be subject to modification as and when evidence based practice becomes available.

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Author	Owner	Revision	Active Date	Review date	Page
MCC/ NH	NH	2.2	04/02/2021	02/2023	16 of 16
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