Steps to Establish a Proper Diagnosis

Subjective findings: Assemble facts

- 2.A Ascertain the chief complaint
- 2.B Take a detailed medical and dental history
- 2.C History of the present condition

Examination and investigations

- 2. D. Conduct all necessary objective and subjective examinations

Interpretation from the assembled evidences

- Analyze the data
- 2. E. Formulate an appropriate diagnosis, differential diagnosis and treatment plan

Subjective findings

2. A. Chief Complaint

The chief complaint is the reason(s) that the patient provides for consulting the dentist. Listening carefully to the patient's description of his/her symptoms can provide invaluable information. This information may lead directly to the problem, or in some cases will offer relevant clues that will facilitate one to arrive at an accurate diagnosis after the completion of the examination. Most orofacial pain is of pulpal or periradicular origin and the pain to thermal stimulus is often an indication of an endodontic problem.

2. B. Medical History

It is one of the most important responsibilities of the clinician to document a proper medical history of the patient. The medical history may provide relevant information related to the health status of the patient, and will offer the dentist knowledge of preexisting medical conditions and current medications that may necessitate altering the manner in which dental care is provided. If there is any doubt about the state of a patient's health, his/her general medical practitioner should be consulted before any endodontic treatment is commenced. This also applies if the patient is on medication, such as corticosteroids or an anticoagulant. Certain medical conditions may have oral manifestations or mimic dental pathosis. Pathologic conditions such as neuralgia, multiple sclerosis, myocardial ischemia and psychiatric disorders may also produce symptoms that are confused with tooth pain. To avoid misdiagnosis and to rule out orofacial pain that is not of endodontic origin, the clinician should identify and document all signs and symptoms that are confused with tooth pain. The clinician should also be aware of drug allergies, dental products allergies, artificial joint prosthesis, organ transplants, and medications that may interact negatively with common local anesthetics, analgesics, and antibiotics. or Prophylactic antibiotic coverage has been recommended for certain medical conditions, depending upon the complexity of the procedure and the degree of bacteraemia expected, but the type of antibiotic and the dosage are under continual review and dental practitioners should be aware of current opinion.

2. C. Dental History

Specific information closely related with the chief complaint must be recorded as the dental history. This information is critical because it will guide the dentist as to which tests/investigation is to be performed. It is not only important to record the presenting symptoms but the past findings as well. Problems from endodontic origin usually have a past history of pain. After having all this previous information, the dentist is ready to start with the clinical testing and examination that will end with the establishment of a final diagnosis. The periodontium, jaws, sinuses, ears, temporomandibular joints, masticatory musculature, nose, eyes, blood vessels and other structures may induce pain that mimics pulpal pain.

2. D. EXAMINATION AND TESTING

A clinical examination of the patient is carried out after the case history has been completed. It is important to realize that the problems must not be dealt with in isolation and any treatment plan should take the entire mouth and the patient's general medical condition and attitude into consideration.

Extraoral Examination

The clinician must be ready to notice any signs of physical limitations, as well as facial asymmetry from the very first time the patient enters the office. Visual and palpation examinations of the face and neck are very important in determining any swelling, lymphadenopathy, or extra-oral sinuses. Extraoral facial swelling of odontogenic origin typically is the result of endodontic etiology, as periodontal problems rarely produce abscesses. Non odontogenic swelling also have to be considered, especially if no obvious dental etiology is found.

Intraoral Examination

Intraoral soft tissues should be routinely examined. The gingiva and mucosa are to be checked by drying them and retracting tongue and cheeks. Abnormalities in color and texture, and raised lesions or ulcerations should be recorded as well. An assessment of the patient's general dental status is usually made by noting in particular the following aspects: standard of oral hygiene, amount and quality of restorative work, prevalence of caries, missing and unopposed teeth, general periodontal condition, presence of soft or hard swellings, and presence of any sinus tracts, discoloured teeth, tooth wear and facets. Intraoral swelling must be documented to detect its possible origin by means of performing different testing methods

Sinus tract and Sinogram

A sinus tract is an intraoral communication to the gingival surface. This communication/pathway extends directly from the source of infection to the surface (intraoral surface or extraoral surface). Lesions with sinus tract usually are not painful. The stoma of the intraoral sinus tract may open in the alveolar mucosa, attached gingiva, or on the furcation or gingival crevice. A cutaneous sinus tract of dental origin is relatively uncommon and may be misdiagnosed easily. These sinus tracts are most commonly found on the chin or in the submandibular area. However, all chronic draining sinus tracts of the face or neck should signal the need for thorough dental evaluation. Tracking a sinus tract will provide an important clue for the proper diagnosis. An adequate size of Gutta-Percha point (for example size #25) is pushed into the opening of the sinus tract until resistance is felt, then a radiograph taken (sinogram).

Palpation

The soft tissues overlying the root apices of suspect and control teeth are palpated to locate tender areas. The site and size of any soft or hard swellings are also noted and examined for fluctuation and crepitus.

Percussion

A percussion test may be used to duplicate the symptoms when the patient refers pain upon mastication. This test will aid in isolating the sensitivity to a particular tooth. Pain to percussion is not an indication of tooth vitality, but will indicate the existence of inflammation in the periodontal ligament. The etiology of the sensitivity to percussion may be trauma, occlusal prematurities, periodontal disease, or extension of pulpal disease into the periradicular area. The testing for percussion sensitivity should initially be carried out gently, with light occlusal pressure, applied digitally with a finger. If the patient does not experience any pain, the test should be repeated with the blunt end of an instrument (hind end of a mirror handle). If the patient recognizes no difference, the test should be repeated on the buccal and lingual surfaces of the teeth. If the sensitivity to percussion is from endodontic origin, usually only one tooth will be sensitive, if two adjacent teeth are sensitive to percussion, differential diagnosis should be considered (such as: proximal caries or inadequate proximal restoration).

Mobility

The increase in the mobility of a tooth is not necessarily an indication of pulpal infection. It indicates that the health of the periodontal tissues is compromised. The cause for tooth mobility may be trauma, trauma from occlusion, parafunctional habits, periodontal disease, root fractures, orthodontic movement or an extension of pulpal disease.

The mobility test must be done with the hind ends of two mirror handles, one on the buccal aspect of the tooth and one on the lingual aspect of the tooth

Periodontal examination

The gingival sulcus is an area of potential space between a tooth and the surrounding gingival tissue. The depth of the sulcus is bounded apically by the gingival fibers of the connective tissue attachment and coronally by the free gingival margin. The periodontal pocket is a pathological deepening of the gingival sulcus. The periodontal pocket depth is measured from the height of the free gingival margin to the height of the attachment apparatus apically. A calibrated periodontal probe is used for this purpose. It is important to record the periodontal pocket depths on the mesial, middle and distal aspects of both buccal and lingual sides of the tooth. Periodontal bone loss is considered to be of periodontal origin; while an isolated area of vertical bone loss may be of an endodontic origin. Vital pulp testing will be helpful in confirming the origin. A vertical root fracture may cause a localized narrow periodontal pocket.

Vitality Test

Pulp testing is utilized to determine the status of the sensory neurons present in the pulp and the integrity of the pulpal vasculature. Unfortunately, the quantitative evaluation of the status of the pulp may be determined only by histological examination. Studies have demonstrated a lack of good correlation between the objective clinical signs/symptoms and histo-pathological status of the pulp.

Thermal test

A thermal test commonly employs either hot or cold approaches. A normal response is determined if the patient describes that the sensation is felt but disappears immediately after removal of the thermal stimulus. In the case of an abnormal response, the patient may not experience any sensation, or may experience lingering or intensification of the sensation or an immediate, excruciatingly painful sensation after the thermal stimulus is applied on the tooth. For both hot and cold tests it is recommended to isolate the tooth with a rubber dam.

Heat test is used when the patient complains about pain upon contact with hot food/ drinks. Heat test is performed by spraying warm water from an irrigating syringe on the teeth that are believed to be affected. The teeth involved in the test should be isolated individually. Heated gutta-percha or a compound stick or using a rubber cup with slow speed motors is also used to conduct a heat test. Application of a small amount of lubricating material over the surface to be tested is advised to avoid the adherence of the test material on to the tooth surface.

Cold test can be conducted by using frozen carbon dioxide delivered using a specially designed plastic cylinder. The CO2 stick is applied to the facial surface of the tooth crown during testing. The most common method to perform a cold test is with refrigerant spray, which provides reproducible, reliable and equivalent result as with the CO2 stick. The current product contains Tetrafluorethane (-26.2 C), which is applied on to the tooth surface with the help of a large #2 cotton pellet. The sprayed cotton pellet is applied to the mid buccal surface of the crown. Cold test is considered to be a more reliable test when combined with the electrical pulp test. If a mature untraumatized tooth does not respond to both tests it must be considered necrotic. As a general rule, the adjacent teeth must be tested to compare the findings. False positive responses to cold in multi-rooted teeth may be due to the presence of vital pulp tissue remaining in at least one canal, especially when the pulp is only partially necrotic. On the other hand, if the source of cold is applied very close to the soft tissues, the patient may experience pain or sensitivity that is not related to the tooth being tested, but associated to these soft tissues. False negative responses to cold may be found in cases of calcified tooth tissue which is a more common finding in elderly patients.

Electric test

The response of the pulp to the electric pulp testing does not reflect the histologic health or disease status of the pulp. A response to electric pulp test only indicates that some viable nerve fibers are present in the pulp and are capable of responding to mild electric current. Numerical readings on the pulp tester have significance only if the number differs significantly from the readings obtained from a control tooth tested on the same patient with the electrode positioned at a similar area on both teeth. Lack of response is usually found in necrotic pulps. Differential diagnosis should be assessed if lack of response is found with recently traumatized teeth.

To perform the electric test, the probe of the electric pulp tester should be placed in contact with the natural tooth and the patient may be required to place a finger(s) on the tester probe to complete the electrical circuit. There is also the option for lip clips to perform the same propose. It is recommended that the tooth to be tested is isolated and dried, and tested at least twice. The probe must be coated with a petroleum based conductive medium (example: tooth paste) before touching the tooth surface. The patient is instructed to hold the tester probe and to remove his/her finger(s) once a tingling or warming sensation is felt. The clinician has to record the readings from the pulp tester. This test may evoke a false positive response when used to test non-vital teeth with large metallic restorations, which are capable of conducting electrical impulses to the periodontal tissues. This may lead to a false-positive response from teeth with necrotic pulp tissue. Similarly, a false positive response may be obtained if the break down products from the pulp is capable of conducting the electrical current. Electric pulp testing is unreliable when used to test the vitality of young teeth in patients less than 10 years of age, in recently traumatized teeth, and on teeth with artificial crowns.

Laser Doppler flowmetry

This method is non-invasive and an objective method to determine the pulpal blood flow. It applies the principles of the Doppler Effect. A diode is used to project a red or near infrared light beam into the tissue that is to be tested. The infrared light beam is scattered as it passes through the pulp tissue. The Doppler principle states that the light beam will experience a frequency shift caused by the moving red blood cells but will remain unshifted as it passes through a static tissue.

Laser Doppler measurements may be highly susceptible to (1) Environmental changes (temperature), (2) Techniques (stability of probe, accurate placement of probe), (3) Tissue variability between individuals and (4) non-pulpal signals (gingival, periodontal blood flow).

Pulse Oximetry

Pulse Oximetry is designed to measure the oxygen saturation level in the blood and the pulse rate. This objective test works by transmitting two wavelengths of light, red and infrared. A certain degree of light is absorbed as it passes through the tissue; how much is absorbed depends on the on the ratio of oxygenated and deoxygenated hemoglobin in the blood. On the opposite side of the targeted tissue, a sensor detects the absorbed light, and on the basis of the difference between the light emitted and the light received, a microprocessor calculates the pulse rate and oxygen concentration in the blood. During testing, the sensor should conform well with the anatomy of the tooth so that all emitted light is received by the detector. The presence of metallic restorations interferes with measurements by Pulse Oximetry. This test is very useful when testing teeth that have suffered traumatic injuries. However, patient conditions such as low peripheral perfusion, hemoglobin disorders, vasoconstriction, hypotension, increased acidity and metabolic rate could interfere with measurements. These methods are not commonly used in clinical settings.

Radiological Interpretations

Radiological interpretations are an important step in clinical examination. A necrotic tooth does not cause radiographic changes at the apex until the periapical pathosis has destroyed bony trabeculae at their junction with the cortical plate. Though it will not be able to provide information about the condition of the pulp or the types of pulpitis, it is can provide useful indications on the (a) carious lesions not identified in clinical examination (b) pulp stones and patency of the root canal, (c) number and course of tooth roots (d) root resorption (e) internal resorptions (f) width of the periodontal ligament space (g) condition of apical tissue (h) condition of the periodontal attachment and (i) presence of root fractures. Radiological diagnosis of the affected tooth is mandatory prior to any root canal treatment. If not, complications arising during endodontic treatment may have legal consequences.

Generally, it is believed that the deeper the caries and more extensive the restoration the greater is the probability of pulpal involvement. Following the lamina dura usually reveals the number and curvature of the roots. A root canal should be readily discernible. If the root canal appears to change quickly from dark to light, this indicates that it has bifurcated or trifurcated. It is important to remember that the presence of extra roots or canals in all teeth is much more common than was previously believed.

Cone bean CT, other scans: Cone beam computed tomography (CBCT), ultrasound, and other emerging technologies seem to be very promising tools for more accurate diagnosis of changes in the root supporting structures.

Computed tomography uses a fan-shaped beam and multiple exposures around an object to reveal the internal architecture of this object. In this way, the clinician can view

morphologic features as well as pathology from different three-dimensional (3D) perspectives. However, if radiopaque obturation materials are present, there can be scattering and creation of artifacts, which can significantly hamper visualization. With malignant tumors, information on the size of the lesion, encroachment on vital structures, and the likelihood of metastasis to lymph nodes might aid in the choice of surgery versus radiation therapy

CT endodontic applications allow for 3D reconstruction of root canals. Three-dimensional information along with tactile feedback during instrumentation gives the clinician a more thorough understanding of the true morphology of root canals

SPECIAL TESTS

Bite test

During a bite test, the clinician applies pressure to individual cusps or areas of the tooth. Different approaches have been used for the bite test. The tooth slooth is frequently for bite test. The small cupped area on the tooth slooth is placed in contact with the cusp to be tested. The patient is asked to apply biting pressure with the opposing teeth to the flat surface on the opposite side of the device. The clinician should monitor presence of pain upon closing or upon releasing the occlusal pressure. A common finding with a fractured cusp or cracked tooth is the presence of pain on the release of biting pressure.

Cavity test

For the cavity test, a small class 1 cavity preparation is made on the occlusal surface of the crown with a high speed handpiece and round burs #1 or # 2 with proper air and water coolant. The patient is not anesthetized, and the patient is asked to respond if any painful sensation is felt. The presence of pain may indicate the existence of viable nerve tissue in the pulp. On the contrary, absence of sensation indicates a necrotic pulp.

Staining and Transillumination

This test is mainly used to determine the presence of cracks or vertical crown fractures. A stain or a bright fiberoptic light illumination is used for this purpose. During transillumination, it is recommended to reduce overhead lighting as much as possible and to place the transilluminator on the buccal gingival area of the suspect tooth. The transilluminator is then moved slowly from the mesial to distal side while observing from the occlusal for a dark line, since fractured segments do not transmit light. Cracks in teeth may also be detected by a wedging and staining procedure. A dye (for example Methylene Blue) is usually placed on the occlusal surface of the tooth before wedging,

and the occlusal surface is cleaned with a cotton pellet lightly moistened with 70% isopropyl alcohol. The alcohol washes away the dye on the surface, but the dye within the fracture line remains and becomes apparent.

Selective anesthesia

This test is applied when the patient is not able to isolate the cause of the pain, particularly to a specific arch. During this test, the clinician should first anesthetize selectively the maxilla by using intraligamentary anesthesia, starting with the most posterior tooth. The anesthesia is then administered in the anterior direction one tooth at a time, until the pain is eliminated. If the pain continues, the procedure must be continued on the mandibular teeth.

3. DISEASES OF PULP

3. A. Classification of Pulpal Pathosis

1. **Reversible Pulpitis**

This is usually indicated by localized inflammation of the pulp with localized increase in the intrapulpal pressure. The threshold of stimulation for A delta nerve fibers is lowered. The patient may experience exaggerated, nonlingering response to stimuli. The pulp tissue in reversible pulpitis is able to accommodate increased pressure and repair the damage. Caries or irritants should be removed and a sedative dressing should be placed.

2. **Irreversible Pulpitis**

This is usually associated with a localized area of necrosis in the pulp, which cannot be repaired or confined. The associated inflammation frequently spreads throughout the pulp. In these situations, the pulp usually has preexisting chronic pulpitis, which decreases the ability of pulp to respond favorably to vital pulp therapy. The mediators of inflammation (bradykinin) directly stimulate the fibers. The presence of inflammatory mediators in the pulp also lowers the threshold of stimulation for all intrapulpal nerves. PMNs (polymorphonucear leukocytes) are involved and they cause exacerbation of inflammation. In irreversible pulpitis, pain lingers after the thermal stimulation of A delta nerve fibers. The patients also present spontaneous dull, aching pain caused by the stimulation of unmyelinated C fibers in the pulp. Endodontic therapy is required in cases of irreversible pulpitis and If left untreated may end up with complete necrosis.

3. **Pulp Necrosis**

Necrosis of the pulp caused by the inflammation of the pulp due to caries will most probably spread to the periradicular tissues, while, the necrosis of the pulp caused by trauma that severed the blood supply to the tooth would result in a dry necrosis that may not spread to the periradicular tissues. Endodontic therapy is advised in these cases.

3. B. CLASSIFICATION OF PERIRADICULAR PATHOSIS

1. Acute Periradicular Periodontitis

Acute periradicular periodontitis indicates inflammation in the PDL (periodontal ligament) caused by tissue damage and the extension of pulpal pathosis or occlusal trauma. Accumulation of PMNs causes rapid buildup of edematous fluid in the PDL. The pressure on the tooth induced by occlusion / percussion is transmitted to the fluid which compresses the nerve endings in the PDL. The pain will remain until bone is resorbed, the fluid is drained or the irritants are removed. The tooth in this case may be elevated out of its socket because of the buildup of fluid pressure in the PDL. Usually, Acute Periradicular Periodontitis does not present any radiographic changes since they occur rapidly. The pulp tests are essential and the findings must be correlated with other diagnostic information in order to differentiate inflammation of pulpal origin from occlusal trauma.

2. Acute Periradicular Abscess

In Acute Periradicular Abscess, a large number of bacteria pass the apex into the periradicular tissues. This implies a breakdown of the host immune system, which usually contains the microbes inside the root canal system. The acute inflammatory response is observed with the PMNs being the dominant cells in this condition. This results in a local collection of purulent exudates. These cases may not have radiographic evidence of bone loss since fluids are rapidly spread away from the tooth. Clinically, swelling to various degrees is present along with pain and a feeling that the tooth is elevated in the socket. The infection may spread along the facial planes to form a cellulitis, and systemic symptoms such as fever, malaise may be present in these patients.

3. Chronic Periradicular Periodontitis

a) Periradicular granuloma

This is characterized by a relatively low-grade, long-standing lesion formed to neutralize irritants from the canal system and wall them off from the rest of the body. As long as the irritants keep emanating from the root canal system, the soft tissue lesion will keep expanding at the expense of the surrounding bone. Microscopically, this granulomatous tissue is comprised of lymphocytes, plasma cells, and macrophages surrounded by a

relatively uninflamed fibrous capsule made up of collagen, fibroblasts, and capillary buds. Clinically, this lesion is asymptomatic and is detected radiographically by a periradicular radiolucency

b) Periradicular cyst

A cyst is a three-dimensional epithelial lined cavity filled with fluid. Periradicular cyst development occurs if the inflammation of the periradicular tissue stimulates the epithelial rests of Malassez to begin dividing. A cyst may develop within the granuloma. The lumen of the cyst may or may not communicate with the apical foramen of the root canal. In a "bay cyst" lumen communicates with the apical foramen and may heal with nonsurgical root canal treatment. In a "true cyst" lumen does not communicate with the apical foramen. It requires a surgical root canal treatment.

4. Chronic Suppurative Periodontitis

Chronic Suppurative Periodontitis are apical lesions that have established drainage by breaking through the cortical plate of the bone and overlying periodontal tissues. In these cases, a "sinus tract" is present, and the patient is usually asymptomatic.

5. Phoenix Abscess

Phoenix abscess is an acute periradicular abscess superimposed on a preexisting chronic periradicular periodontitis. It is an acute exacerbation of a previously existing chronic lesion. It is a result of an increase in the virulence of the bacteria or decrease in the patient's resistance. Clinically, the patient exhibits the same symptoms as that of an acute periradicular abscess, however, radiographically there is a radiolucency associated with the tooth.

6. Focal Sclerosing Osteomyelitis (Condensing Osteitis)

Focal Sclerosing Osteomylitis occurs because of a very low grade pulpal inflammation which results in an increase in the bone density rather than resorption. Clinically, the patient is usually asymptomatic, while radiographical evaluation of the periradicular area shows increased bone density and trabeculation. Histologically, a mild chronic inflammatory infiltrate is associated with the osseous tissue. RCT (root canal treatment) is not indicated unless there is other evidence of pulpal inflammation. The radiopacity may persist after RCT and extraction of the tooth.

4. ENDODONTIC DIAGNOSTIC TERMINOLOGY/ CLASSIFICATION FROM THE AMERICAN BOARD OF ENDODONTICS (ABE)

In an effort to simplify and unify the endodontic diagnostic terminology, the ABE has recently published a list of pulpal and periapical diagnostic terminology. A complete endodontic diagnosis is made up of two parts: (1) Pulpal diagnosis and (2) Periapical diagnosis. Additional terminologies used are (a) Symptomatic – Lingering thermal pain, spontaneous pain, referred pain, (b) Asymptomatic – No clinical symptoms but inflammation produced by caries, caries excavation, trauma, etc.

4. A. PULPAL DIAGNOSIS

Normal pulp – A clinical diagnostic category in which the pulp is symptom free and normally responsive to vitality testing.

Reversible pulpitis – A clinical diagnosis based upon subjective and objective findings indicating that the inflammation should resolve and the pulp return to normal.

Irreversible pulpitis – A clinical diagnosis based on subjective and objective findings indicating that the vital inflamed pulp is incapable of healing.

Pulp necrosis – A clinical diagnostic category indicating death of the dental pulp. The pulp is non-responsive to vitality testing.

Previously Treated – A clinical diagnostic category indicating that the tooth has been endodontically treated and the canals are obturated with various filling materials, other than intracanal medicaments.

Previously Initiated Therapy – A clinical diagnostic category indicating that the tooth has been previously treated by partial endodontic therapy (e.g. pulpotomy, pulpectomy).

4. B. PERIAPICAL DIAGNOSIS

Normal apical tissues – Teeth with normal periradicular tissues that will not be abnormally sensitive to percussion or palpation testing. The lamina dura surrounding the root is intact and the periodontal ligament space is uniform.

Symptomatic apical periodontitis – Inflammation, usually of the apical periodontium, producing clinical symptoms including painful response to biting and percussion. It may or may not be associated with an apical radiolucent area. (This category includes what many of us call Acute Apical Periodontitis & Phoenix Abscess).

Asymptomatic apical periodontitis – Inflammation and destruction of apical periodontium that is of pulpal origin, appears as an apical radiolucent area and does not produce clinical symptoms. (This is what many of us have previously called a Chronic Apical Periodontitis)

Acute apical abscess – An inflammatory reaction to pulpal infection and necrosis characterized by rapid onset, spontaneous pain, tenderness of the tooth to pressure, pus formation and swelling of associated tissues.

Chronic apical abscess – An inflammatory reaction to pulpal infection and necrosis characterized by gradual onset, little or no discomfort and the intermittent discharge of pus through an associated sinus tract.

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