EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 6
Issue: 3
490-493
Year: 2019

INTERVENTIONAL RADIOLOGY- A NEW VISION IN DENTISTRY

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Article Received on 10/12/2019 **Article Revised on 01/02/2019** **Article Accepted on 22/02/2019**

INTRODUCTION

The wide array of interventions in the field of Radiology has led to the development of Interventional Radiology which is a booming concept that involves minimally invasive procedures to diagnose and treat conditions which earlier required an open approach.[1] The British Society of International Society defines "Interventional Radiology" as a range of techniques which rely on the use radiological image guidance (X-ray fluoroscopy, ultrasound, computed tomography [CT] or magnetic resonance imaging [MRI]) to precisely target therapy.[2] Interventional Radiology can be precisely called an amalgamation of radiology with interventional therapy. Interventional radiology is usually misinterpreted being a part of medical science only. In dentistry too, interventional radiology plays a prominent role in several diagnostic procedures and therapeutic procedures[1] This paper aims to clarify the role of interventional radiology in dental sciences and hence aims at improving the quality of dental care in the wide spectrum.

DISCUSSION

Temporomandibular Joint (TMJ)

Arthrogrpahy: Arthrography is a method in which injection of contrast media (negative contrast media – air, positive contrast media -iodine contrast) is used with preauricular or transmeatal puncture site. With this technique internal structure of the joint as well joint discus is very well demonstrated.

There are three techniques which are in use

a) Visualization of lower TMJ joint space with monocontrast (iodine contrast);
b) Visualization of upper and lower joint space with double contrast (iodine contrast + air);
c) Visualization of upper and lower joint space with monocontrast (iodine contrast).

Arthrography allows visualization of elements such as osseous anatomy, disc position, size, or shape, presence of perforated disc, reduction of the disc to normal position, disc dislocation without reduction, dynamic anatomy and movement of the joint. This procedure has not been widely used but it is the ultimate imaging method in the patients in whom the diagnosis of internal TMJ is not possible by other imaging methods. It can also be used in diagnostic dilemmas and in the precise planning for surgery.

Arthrography is indicated for an evaluation of the soft-tissue components of the TMJ, especially disk position, function, and morphology in those patients presenting with a suspected internal derangement. There are two important imaging modalities for TMJ arthrography. In single-contrast arthrography, radiopaque material is injected into either the lower or upper joint space, or into both compartments. In double-contrast arthrography, a small amount of air is injected into the joint space after the injection of contrast materials.[3]

Arthroscopy

Arthroscopy is a technique for direct visual inspection of internal joint structures, including biopsy and other surgical procedures performed under visual control.[7]

The arthroscopic endoscope is a very practical tool for visualizing the interior of joints in vivo. The last twenty five years have seen the development of precisely engineered instruments that are both small and strong, equipped with powerful light sources, fibreoptic light guides and optic systems that can transmit a clear image through a telescope less than 2 mm in diameter. A chip colour TV Camera can also be mounted on an arthroscope in order to magnify the image. For the patient, the benefits of arthroscopy include more accurate diagnosis, more precise surgery, much less in surgical trauma, and more rapid rehabilitation.[8]

Arthroscopic surgery is probably among the safest procedures in which a 1.9 or smaller arthroscope is placed in the TMJ either through a posterior puncture or an anterior puncture or portal. Scopes as long as 2.3 have been used, and even working instruments as large as almost 3 mm can be utilized with or without the protective casing. Arthroscopy can be as simple as a single puncture in the TMJ with an outflow system created with an 18- gauge needle to a more complex procedure using multiport or triangulation techniques involving the use of 1 portal for the arthroscope and the second portal for instrumentation.[6]

Another technology that lends itself to complex TMJ surgical procedures such as ankylosis is image-guided surgery. This technology, although developed either for intracranial surgery or ear, nose, and throat surgery, is directly applicable to TMJ surgery. In this context, a surgical wand that allows the surgeon to identify their position on a computed axial tomography (CAT) during surgery can be used. Currently, there are 3 companies that support this type of technology, each one having the maxillofacial component. They are Brain Lab, Stryker, and Medtronics.[6]

Salivary Gland

Conventional Sialography

Sialography is a valuable diagnostic procedure in the treatment planning of disease conditions of the major salivary glands.

A complete sialographic examination should include 3 stages

a. Filling stage performed under fluoroscopic control and spot filmed during the initial visualization of the duct system

b. Parenchymal opacification stage for the study of the gland parenchyma beyond the duct system

c. Postevacuation stage for the study of secretory activity of the gland and to detect any destruction of the walls of the duct system or the acini.[4]

Sialography with fluoroscopy and tomography has increased the accuracy of detecting and delineating mass lesions of the parotid gland. Lesions which are small, at the periphery of the gland, or in the deep lobe are often most clearly visualized on tomographic sections.[5] Conventional sialography and digital subtraction sialography both show good efficacy in the visualization of sialectasis, strictures, and filling defects. The inherent static nature, the complex bony background, and the number of projections that are obtained limits conventional sialography. Digital subtraction imaging (DSI) allows real-time imaging and postprocessing.

Interventional sialography has evolved since the early case reports of duct dilatation and calculus extraction. The techniques have improved with the use of more sophisticated technology, which has expanded to include intra- and extracorporeal lithotripsy, ductal endoscopy, and the use of cutting angioplasty balloons.

There have been a large number of devices used for extracting sialoliths. These range from embolectomy catheters to angioplasty balloons and vascular snares. These devices commonly reflect readily available tools with which interventional radiologists have experience and that can be adapted for use in the salivary glands. There has been a clear trend toward short-tipped, wire retrieval baskets. The short tip facilitates extraction of proximal calculi. These may be introduced through an access sheath that facilitates extraction in tortuous or kinked ducts.

Per oral balloon ductoplasty is frequently reported and appears to be a technically successful procedure. Many devices have been used, including over-the-wire angioplasty balloons introduced over 0.018- or 0.035-inch wires. These can be used to dilate the parotid duct up to 5 mm and the submandibular duct to 3 mm. Similar techniques of duct accessing as described in sialolith extraction have been reported.[10]

Sialoendoscopy

Sialendoscopy is a new procedure, aiming to visualise the lumen of the salivary ducts and their pathologies.It uses minimal invasive surgical techniques which allows for optical exploration of the salivary ductal system and extraction of the stones by a basket under endoscopic view. Sialendoscopy incorporates diagnostic with therapeutic procedures, as dictated by the clinical findings. This technique can be performed in most cases as an ambulatory, outpatient procedure under local anaesthesia. They are two types of sialendoscopy, diagnostic and interventional. The diagnostic and interventional sialendoscope (1.33 mm^2 surface, 1.3 mm diameter) provides excellent vision and is recommended both for diagnostic and interventional procedures as it has a rinsing channel as well as a working channel. Recently new generations of all-in-one endoscopes became available to be used for the same purposes.[9]

Image Guided Biopsies: Ultrasound-guided FNA is a well-established technique for localizing lesions of the thyroid, salivary glands, and cervical lymph nodes, but lesions deep to the bony structures of the facial skeleton and air-containing spaces of the head and neck are not easily localized with ultrasonography.

Ultrasound images using B-mode can precisely visualize normal and abnormal anatomical structures and can clearly identify the presence or absence of mass-like lesions in oral and maxillofacial regions. Therefore, US examination can readily detect and diagnose salivary gland- and lymph node-related diseases and is a very useful tool for FNA biopsy (FNAB). OK-432 (picibanil), a biological response modifier used for sclerotherapy, has been used as a nonsurgical treatment for ranulas in the oral floor using USGFNA.

Magnetic resonance imaging provides excellent soft tissue detail, exceeding that of CT, but does not provide bony detail. Magnetic resonance imaging–assisted needle biopsy has been performed with good results and minimal morbidity. Because of the tight confines of the MRI scanner, open MRI scanners are preferable, but they are not widely available.

A CT scan provides good soft tissue and bone detail and does not have the drawbacks of MRI in image-guided biopsy procedures.[11]

CT-guided fine-needle aspiration (FNA) and biopsy are safe and effective for obtaining tissue for diagnosis of lesions of the head and neck . CT-guided FNA yields a diagnostic sample in more than 90% of head and neck masses, and the correct diagnosis is established in approximately 88% of cases. CT-guided core needle biopsy also yields accurate tissue samples, which are diagnostic in 73–90% of head and neck biopsies. The advantages of CT over ultrasound guidance include the relative insensitivity of CT to artifact arising from air-containing structures, its detailed anatomic depiction of deep facial structures, and the availability of contrast-enhanced images to define critical vasculature . CT guidance also is useful for assessing postprocedural bleeding. After the sampling procedure is completed, we obtain a limited-range CT scan centered at the biopsy site to assess for postprocedural hematoma. Although CT guidance exposes the patient to radiation, this can be mitigated by adjusting the imaging parameters used during the procedure.[12]

Tretament of Vascular Lesions

Vascular malformations were thought to be treated by surgeons alone. The early rationale of proximal arterial ligation of arteriovascular malformations (AVMs) proved totally futile as the phenomenon of neovascular recruitment reconstituted arterial inflow to the AVM nidus. Microfistulous connections became macrofistulous feeders. Complete surgical extirpation of a vascular malformation can be very difficult and, at times even hazardous, necessitating suboptimal partial resections. Partial resections can cause a good initial clinical response that may last for some time. However, commonly the patient's presenting symptoms recur or worsen at follow-up. Because of the significant blood loss that frequently accompanies surgery, the skills of interventional radiologists have been employed to embolize these vascular malformations preoperatively. This not only allowed more complete resections, it also decreased risk of blood loss during surgery. However, complete removal of a vascular malformation is still a difficult issue and may not always be possible.

Embolization procedures have also evolved as one of the corner stones of modern interventional radiology. The extensive variety of catheters, guidewires, endovascular embolic materials, and imaging systems are a tribute to the hard work, insight, and imagination of the many dedicated investigators in this field. Significant laboratory research, clinical research, and extensive clinical experience has made the judicious use of embolization is a reality in modern clinical practice that will continue to become more common.

There are many embolic agents that are used in various clinical scenarios. The choice of agent depends on factors such as the vascular territory, the type of abnormality, the possibility of superselective delivery of an occlusive agent, the goal of the procedure, and the permanence of the occlusion. For vascular malformations, permanence is a significant issue. It has been documented in the literature that embolization with polyvinyl alcohol, tissue adhesives (glues), fibered coils, and the like are rarely curative, but can provide temporary palliation. With the advent of the use of ethanol, cures at long-term follow-up have been documented. The judicious use of ethanol as an embolic agent has revolutionized our abilities to permanently cure these lesions in the soft tissues.[13]

CONCLUSION

In this era of technology, as new techniques are evolving, Interventional Radiology can bring about a change in the face of dentistry too if practised more. These procedures, if popularly in use can reduce the morbidity associated with dental problems. It is hence important to include Interventional Radiology in Oral Radiology curriculum at the undergraduate as well postgraduate level so that patient's can benefit from these techniques at large. The key to successfully use Interventional Radiology in future is to train the dental fraternity.

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