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ORIGINAL ARTICLE

Comparison of Bone Scan and SPECT/CT in detection of Condylar Hyperplasia

SYED MUHAMMAD MOEEZ HAIDER[1], MUHAMMAD NUMAIR YOUNIS[2], SHEIKH DANIAL HANAN[3], RIMSHA BADER[4]
Department of Allied Health Sciences , University of Health Science , Lahore, Pakistan
Correspondence to Syed Muhammad Moeez Haider, Email: syedmoeez1998@gmail.com

ABSTRACT

Background: Condylar Hyperplasia is a pathology characterized by abnormal growth that causes facial asymmetry. It is an excessive growth of one or both mandibular condyles that affects ramus, body or neck of the mandible. It can eventually cause facial asymmetry, malocclusion, speech and masticatory problems.
Aim: To find out the diagnostic efficacy of Bone Scan and SPECT/CT in detection of Condylar Hyperplasia.
Methods: 33 patients were selected based on the inclusion criteria. Bone Scans were performed and dynamic study comprising Perfusion & Blood-pool phases were acquired immediately after intravenous injection of 99Tcm_MDP. SPECT and CT images were obtained 3-6 hours after the injection.
Results: 14 patients (42.4%) were considered positive on planar bone scan due to the hot spots (radiotracer uptake areas) around TMJ, nose and mandibular region. Yet there was no evidence that these patients were confirmed of the pathology. 3D multi slice imaging was required to confirm the pathology. 10 patients (30.3%) were negative with no hot spots showed. 13 patients (27.3%) were remained suspected and required proper image acquisitions. SPECT CT scans were performed and 28 patients (84.8%) were shown negative. No hot spots shown on mandibular condyles and TMJ confirmed that patients had not been detected of condylar hyperplasia. Only 5 patients (15.2%) confirmed condylar hyperplasia with hot spots on condyles and temporomandibular joint.
Conclusion: Planar bone scan did not effectively separate mastoid, TM joint in 2D image due to these structures lies in close proximity to each other. Planar bone scan was unable to localize the actual sites of higher uptakes. On contrary SPECT CT had confirmed 5 patients with positive uptake values and confirmed the presence of pathology. Due to multi slice imaging acquisitions and detailed information regarding radiotracer activity, distribution and localization, SPECT CT showed better visualization of the structures and provided better understanding of the pathology.
Keywords: Condylar Hyperplasia, Planar Bone Scan, SPECT CT

INTRODUCTION

Condylar hyperplasia (CH) is a pathology in which there is abnormal growth of mandibular co ndyles takes place. In most cases the excessive growth is unilateral that causes facial asymmetry. This excessive growth affects neck, body and ramus of mandibles. It can cause facial asymmetry, malocclusion and other associated problems[3]. Etiology of this disease is not clearly understood. Facial asymmetry, occlusal problems and temporomandibular joint disorder are the most common symptoms. Identifying specific of condylar hyperplasia is crucial[4]. Condylar hyperplasia is divided into many types based on histopathology and etiology features. Condylar hyperplasia can lead to maxillofacial skeletal asymmetry and malocclusion[5]. Hemi mandibular hyperplasia and hemi mandibular elongation are two anomalies that may be presented clinically. Many diagnostic tools have been used to determine the exact nature of this pathology which in turn results in assessment of proper timing and treatment. With correct trimming and treatment, condylar hyperplasia can be treated with a high successful rate[6].

Bone scan is a nuclear medicine test used for the diagnosis of bone pathologies. A small amount of a radioactive material called radiopharmaceutical is injected into the patient. Bone scan is performed for the diagnosis of problems associated with bone metabolism. Bone metabolism is the process by which bones breaks and reforms[7]. Bone scan is a nuclear medicine imaging technique used to evaluate bone pathologies and severity. It helps in assessment of injury, injection and cancer of bones. It also helps to evaluate post treatment conditions of bone and associated pathologies. It is one of the most effective way of determining early bone pathologies, the extent of bone disease and bone metastasis[8]. Radioactive tracers or radiopharmaceuticals are radioisotopes bound to biological molecules able to bind with specific cells, tissues or organs in human body. They can have used for diagnosis as well as therapeutic purposes. The most commonly used radiotracer in bone scan is 99mTc-MDP (methylene diphosphonate). It is taken up by excessive metabolic sites and gets concentrated in bone. Areas of the target organ or tissue which emit high level of radiations (gamma rays) show higher uptake of the radiotracer and shown as red spots (hotspots) on the picture of the computer display. Areas which emit low level of radiations shows low uptake of the radiotracer and are termed as blue spots. Some areas show in between level of radiotracer uptake and shows in varying colours on the computer display. Radionuclide used in the scintigraphy gets accumulated in the areas of the bone where there is a lot of bone activity is occurring i.e. bone cells are breaking or repairing. On the other hand, DEXA scan is used to assess the body density in various bone diseases like osteoporosis[9].

SPECT is an advanced technique in which dual or multiple head gamma detectors are used for 3D imaging acquisitions. Cross sectional images are acquired and merged with CT acquisitions to form a 3D image. With use of multiple heads, sensitivity of SPECT CT system is improved. Two or three acquisitions can be performed together by incorporating the system[10]. Hybrid SPECT-CT is combination of SPECT and multi slice CT system. Detectors head are placed in different orientations for different imaging studies. SPECT performance has no direct effect on CT system. SPECT-CT has a wide range of clinical applications. Sensitivity and specificity of nuclear medicine tests are increased by incorporating both modalities[11]. For oncological diagnosis, SPECT CT has proved its worth[12].

The objective of the study was to find out the diagnostic efficacy of two nuclear medicine tests bone scan and SPECT-CT in detection of condylar hyperplasia.

Rationale: The purpose of this study was to find the correlations and reliability of Planar bone scan and SPECT-CT in detection of condylar hyperplasia. Researches all around the world has suggested that SPECT-CT shows high diagnostic validity in assessment of condylar hyperplasia. Cognizance among people regarding these two scans is low in Pakistan. The availability of Planar bone scan is higher than SPECT-CT in our settings. Data of the local patients having condylar hyperplasia was utilized to compare the efficacy and performance of both scans.

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METHODOLOGY

This study was conducted in the Institute of Nuclear Medicine & Oncology (INMOL), Lahore. The duration of this study was 8 hours from November 2019 to June 2020. A sample of 33 patients has been selected using 90% confidence interval, 10% level of significance, 10% margin of error and 85.8% diagnostic accuracy of SPECT/CT.

$Z21-\alpha/2\ p\ (1-p)$ Sample Size (n)= d2

Where Z= 1.645, p= 0.858, d= 0.10

In planar bone imaging 99Tcm_ MDP is injected to the patient, it eventually accumulates in the area of body under examination. Whole body planar scintigraphy was performed 3 hours after injection[13].

In SPECT-CT 99Tcm MDP is injected and SPECT images were obtained after three to six hours after the injection. Immediately after the SPECT, CT scans acquired. Both SPECT and CT were performed with the patients lying comfortably in the supine position[14].

RESULTS

Planar Bone Scans were performed of all 33 patients. 14 patients (42.4%) showed uptake of radiotracer and were considered positive. 10 patients (30.3) showed no uptake and were considered negative. 9 patients (27.3) showed less or normal uptake and were remained suspected. Out of 14 patients showed positive uptakes of radiotracer, 9 patients (64.2%) showed uptakes on the right side and 5 patients (35.8%) showed uptakes of the left side. None of the patient had showed bilateral uptakes.

Planar Bone Scan Findings		Female	Male	Total
Negative (no Uptake)	Count % of Total	7 21.2%	3 9.1%	10 30.3%
Positive (uptake Shown)	Count % of Total	8 24.2%	618.2%	14 42.4%
	Count	6	3	9
Suspected (less Uptake)	% of Total	18.2%	9.1%	27.3%
	Count	21	12	33
	%of Total	63.6%	36.4%	100.0%

p=0.792

All the 33 patients were under go SPECT CT for further diagnosis. 28 patients were negative which were 84.8% whereas 5 patients were positive with confirm condylar hyperplasia. Out of 5 patients showed positive uptakes in SPECT CT, 3 patients (60%) showed uptakes on right side and 2 patients (40%) showed uptakes on left side. None of the patient had shown bilateral uptakes.

Spect CT findings		Female	Male	Total
Negative	Count	18	10	28
	% of total	54.5%	30.3%	84.8%
Positive	Count	3	2	5
	% of total	9.1%	6.1%	15.2%
	Count	21	12	33
	% of Total	63.6%	36.4%	100.0%
	%of Total	63.6%	36.4%	100.0%

p-value=0.84

Fig.1 Planar bone scan of a 54-year female showed multiple higher uptake areas. Anterior and posterior views showed the uptake on right temporomandibular joint. SPECT CT with 3D reconstruction images were required to fully understand the nature of pathology.

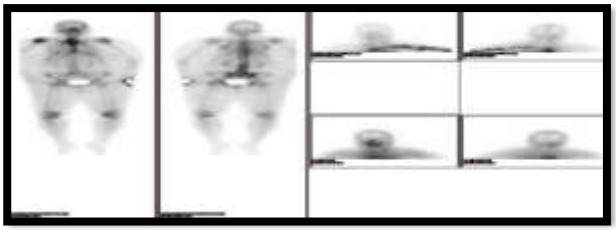


Fig. 2: Planar bone scan of a 70-year old male showed higher uptake on right temporomandibular joint. Blood pool phase images of anterior and posterior views showed the hotspots around TMJ. **SPECT-CT images:**

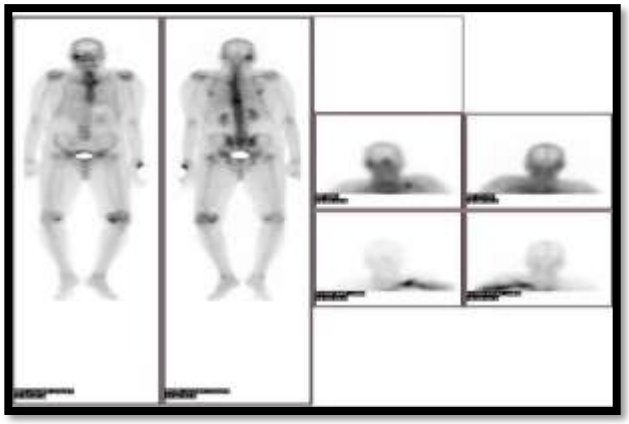


Fig.3 SPECT CT images of 54-year female confirmed the absence of condylar hyperplasia. There were no hotspots on Temporomandibular joint or on mandible condyles. Metabolic and growth activity was showed on temporal bone.

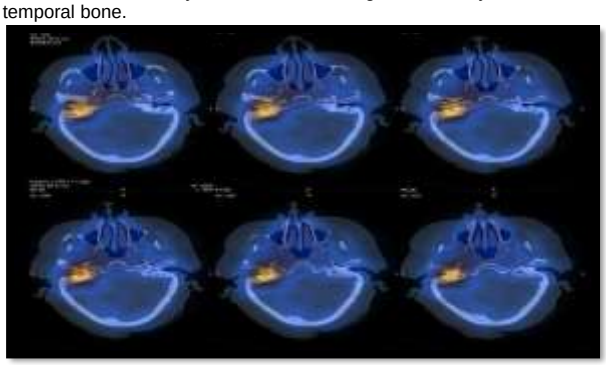
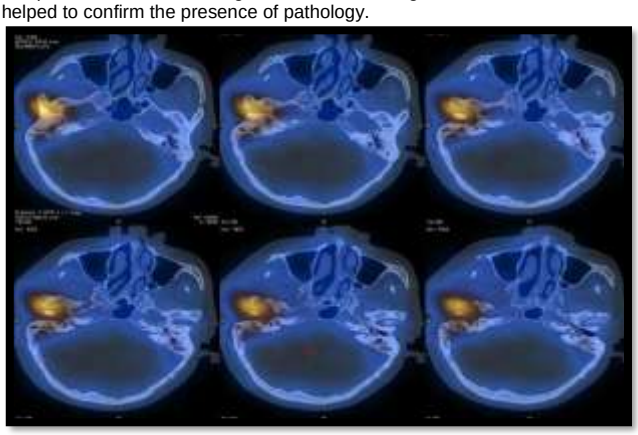


Fig. 4 SPECT CT images of 70-year old male showed higher uptake areas (hotspots) on mandibular condyles. Growth activity was showed on as hotspots in SPECT CT images. SPECT CT images with 3D reconstruction helped to confirm the presence of pathology.



DISCUSSION

Bone scan is a nuclear medicine imaging technique used to evaluate bone pathologies and severity. It involves injecting small amount of radioactive material (tracer) into the vein. The most commonly used radiotracer in bone scan is 99mTc-MDP (methylene diphosphonate). It gets concentrated at the site of increased metabolic derangement of bone[15].

SPECT CT scan is a type of scan which involves fusion of two scans to obtain a detail image which gives precise information about functions and anatomy of various body parts[16]. SPECT-CT scan usually takes 30-40 minutes at least. The first 3-5 minutes are for CT images and involves CT scan components. The remainder time is for the SPECT study. SPECT component does not usually require any additional radiopharmaceutical administration. CT is done with low-dose radiation technique that is around 20-25% of the normal CT scan radiation dose. (16) The fusion of CT and SPECT images provide a better image and detailed interpretation of the location and extent of pathology. SPECT-CT is an accurate method to assess the growth activity of mandibular condyles in condylar hyperplasia. The radionuclide uptake on right and left sides is quantitatively assessed. Condylar dimensions are assessed in the CT portion of the scan. Uptake differences on both sides of the condyles is the basis of the active growth of condylar hyperplasia[17].

Condylar hyperplasia (CH) is a pathology in which there is abnormal growth of mandibular condyles takes place. In most cases the excessive growth is unilateral that causes facial asymmetry. This excessive growth affects neck, body and ramus of mandibles. It can cause facial asymmetry, malocclusion and other associated problems[19]. Facial asymmetry, occlusal problems and temporomandibular joint disorder are the most common symptoms[20].

CONCLUSION

Planar bone scan results had shown 14 patients with positive uptakes but there was no evidence that these patients were actually showing Condylar hyperplasia. Planar bone scan did not effectively separate mastoid, external auditory meatus and TM joint in 2D image due to these structures lies in close proximity to each other. Planar bone scan was unable to localize the actual sites of higher uptakes. On contrary SPECT CT had confirmed 5 patients with positive uptake values and confirmed the presence of pathology. Due to multi slice imaging acquisitions and detailed information regarding radiotracer activity, distribution and localization, SPECT CT showed better visualization of the structures and provided better understanding of the pathology. Other patients had different diseases which planar bone scans were unable to differentiate from condylar hyperplasia. The results of our study favor the SPECT CT as more sensitive and valuable in the diagnosis of mandibular condylar hyperplasia.

Patients included in the study were not given extra radiations as DLP (dose length product) of SPECT CT ranges from 150-300 (mGy cm) which results in no extra patient radiation dose.

Limitation: Study should be multicenter, sample size should be large and costly imaging modality.

Conflict of interest: Nil

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