Original Research Article

Accuracy of SPECT in detecting Condylar Hyperplasia

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Abstract

Background: Condylar Hyperplasia is slowly developing unilateral overgrowth of mandibular condyle for idiopathic causes with consequence of facial asymmetry. Commonly presents between age of 10-25 years with mean around puberty. It seems that UCH is common and frequently occurs in groups during the growth phase, especially in adolescence. Females also appear to be more sensitive to UCH than males, so sex may be considered a risk factor[1]. Correction of the abnormality is contributed to cosmetic or functional reasons. Imaging study play crucial role for determining the diagnosis. There is no treatment for mild cases, although the severe cases can be treated surgically.
Materials and methods: Retrospective study was conducted with sample size of 15 patients. ROI was drawn on both sides of mandible condyle in transaxial section to determine the high activity. Multiple values were calculated.
Results: SPECT imaging and 3D ROI quantification had a sensitivity, specificity and accuracy of 85, 100, and 85% respectively.
Conclusion: SPECT imaging and 3D ROI quantification is feasible and accurate.

Key words

Condylar Hyperplasia (CH), Mandibular, Unilateral overgrowth, Asymmetry, SPECT.

Introduction

Condylar hyperplasia (CH) is a rare disorder characterized by excessive bone growth that usually presents unilaterally, resulting in facial asymmetry. Chin deviated to unaffected side or unchanged. Onset varies: As early as 1st decade, but onset is most often at puberty. Commonly presents between 10-25 years of age with female predilection more than male [1]. CH is most common postnatal growth abnormality of TMJ. Most of patients are seeking for medical advice due to cosmetic reason, while others may have functional limitation. The growth process can continue up to 3rd decade.

Usually, the disease is self-limiting. Unfortunately, the etiology and pathophysiology are not well understood. Many diagnostic tools and criteria have been used to aid in the correct diagnosis of CH, which in turn is critical to determining the appropriate treatments and timing. Imaging wise the diagnosis relays on findings on 3-phase bone scan (Tc-99m MDP). Traditionally, quantitative planar imaging has been utilized to assess metabolic asymmetry, including computing asymmetric ratio (abnormal Vs. normal). However, due to super-imposition, planar imaging may not be accurate. Researches are investigating whither SPECT (Single photon Emission Tomography) would be more accurate and sensitive as compared to planar imaging [2, 3]. The asymmetry associated with UCH can be classified into three categories: hemimandibular hyperplasia, hemimandibular elongation, and a hybrid form. The first type is the result of unilateral growth in the vertical plane, leading to a sloping rima oris, with little or no deviation of the chin. Hemimandibular elongation is characterized by asymmetry in the transverse plane, resulting in deviation of the chin towards the contralateral side [4]. Appropriate therapeutic decisions can be made only after thoroughly assessing the facial asymmetry [5], which is mainly based on subjective clinical evaluation and is supported by bone scans [6, 7].

Although condylar hyperplasia is a self-limiting condition, it is characterized by progressive and independent growth that always results in the bone volume of one condyle being greater than that of the other. According to the growth state, condylar hyperplasia is divided into an active phase and stationary phase. The activity level of the condyle is considered to be highly correlated with mandibular asymmetry [8, 9].

With proper diagnosis, timing, and treatment, CH can be effectively treated with a high success rate. The optimal management of hyperplasia is surgical management (condylar shave or orthodontic-orthographic surgery after growth is completed).

Materials and methods

This was a cross sectional retrospective study conducted at a tertiary care health facility in Riyadh, Saudi Arabia in the year 2018. The study population comprised the patients with facial asymmetry to detect mandibular hyperplasia. Total of 15 patients were studied. The ethical approval was obtained; IRB number 18-141. The data were obtained from PACS system; the cases were reported and labeled with CH. Data were uploaded to MIM 6.6.6 software (we obtained the transaxial section to determine the high activity and to draw ROI). ROI was drawn on both side condyles and comparison was made between gray scale and color contrast images. In gray scale we draw the margin line at interface difference between high and low activity. The other method we used was the color scale, we stick to color outlining the area of interest (**Figure – 1 to 4**).

The following values were our core of the study, which were calculated automatically using the software:

Integral Total (CNTS*ml) Value
Max (CNTS) Value
Mean (CNTS) Value
Mean Ratio (-) Value
Standard Deviation (CNTS) Value
Std Dev Mean Ratio (-) Value
Volume (ml) Value

Figure – 1: Normal condyle activity.

Figure – 2: Normal condyle activity.

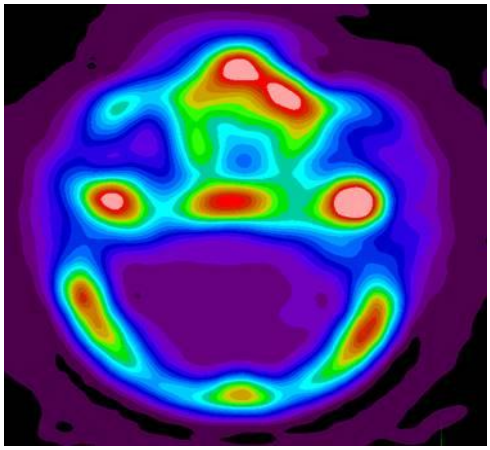


Figure – 3: ROI on black and white.

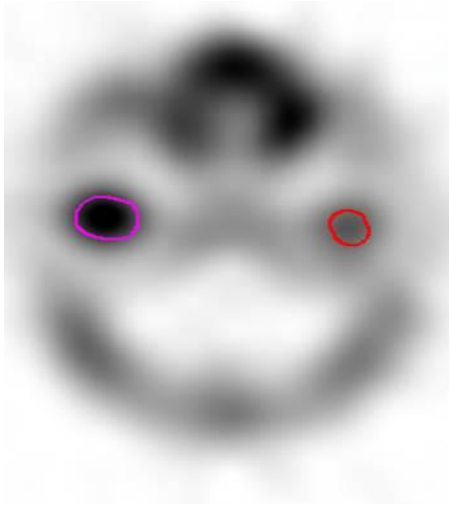
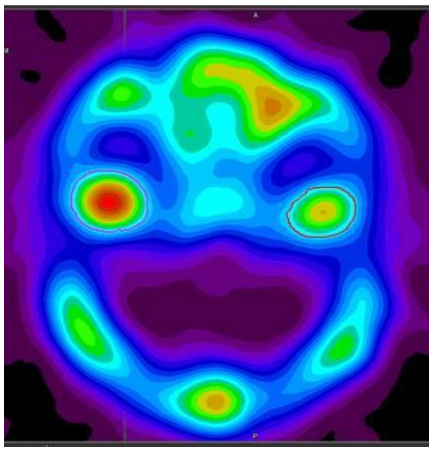


Figure – 4: ROI on color section.



Statistical analysis:
Statistical analysis was performed utilizing ROC analysis (Receiver operating curves) for the most optimum threshold ratios, to separate metabolically normal form abnormal condyles; for the four methods.

Results and Discussion

Retrospective study was conducted with sample size of 15 patients (male = 5, female = 7, 2 cases were normal and 1 severe degraded, mean age = 20.5; age range = 16-36).

Qualitative and quantitative analysis of SPECT/CT were available for 14 out of 15 patients, 1 exam was severely degrarded. SPECT/CT was positive in 12 patients and negative in 2 cases. All cases were confirmed on pathology or on follow-up. Mean and Maximum (with range) Accuracy of Black & White (B & W) and Color scale SPECT with respect to clival activity was as per **Table – 1**.

ROC (Receiver operating curves) analysis was performed for the most optimum threshold ratios, to separate metabolically normal form abnormal condyles; for these four methods were computed, and also a reference line was drawn (**Figure – 5, Table - 2**).

Of the four methodologies, the most accurate was color scale max, at a cut-off ratio - 1.069, the area under the curve on ROC (receiver operator curves) was 0.762, with a sensitivity, specificity and accuracy of 85, 100, and 85% respectively.

Limitation of the study

Small sample size, all patients could not be followed till they reached the adult hood or the condylar activity was reduced. Some patients were lost on follow up.

Conclusion

We have demonstrated that SPECT imaging and 3D ROI quantification is feasible and accurate. However, the study sample is very small and further research is needed with larger sample size. We will be continuing on this study in future.

Table – 1: Mean and Maximum (with range) Accuracy of Black & White (B & W) and Color scale SPECT with respect to clival activity. A= Abnormal, N=Normal.

B&W Mean A/Clivus	**B&W Mean N/Clivus**	**T-test p value**
1.26 (+/-0.40)	1.10 (+/-0.31)	0.003
B&W Max A/Clivus	**B&W Max N/Clivus**	
1.31 (+/-0.54)	0.94 (+/-0.28)	0.0009
Color Mean A/Clivus	**Color Mean N/Clivus**	
1.06 (+/-0.19)	0.94 (+/-0.15)	0.00003
Color Max A/Clivus	**Color Max N/Clivus**	
1.24 (+/-0.41)	0.90 (+/-0.21)	0.0003

Figure – 5: ROC curve.

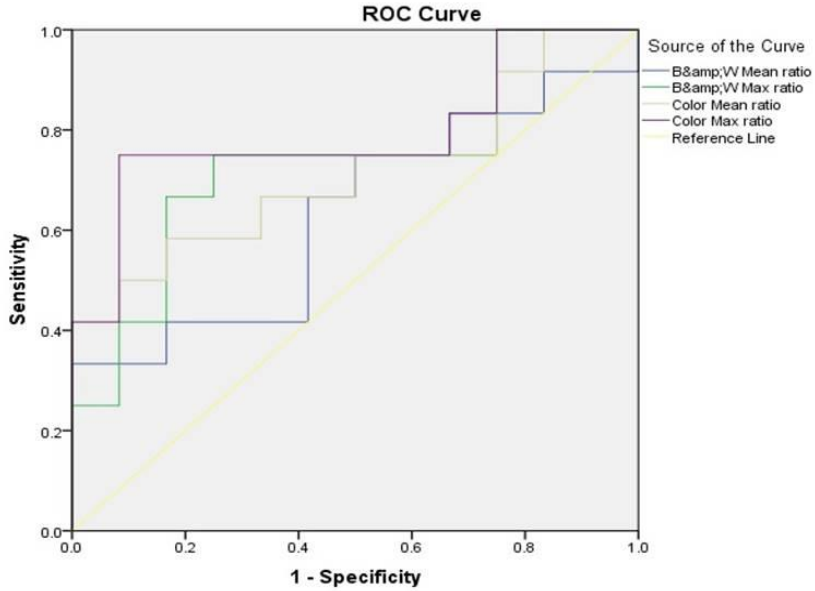


Table – 2: Total readable SPECT=14, 1 was not readable.

	SPECT +	SPECT -
True	12	0
False	0	2

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