

Quantitative Assessment of Radioisotope Uptake in Condyles by SPECT Bone Scintigraphy

Z. Dalili¹, S. Motevasseli², N. Karimi Nasab³, H. Ghanepour⁴, F. Abbaspur⁵

¹ Assistant Professor, Department of Oral and Maxillofacial Radiology, Dental School, Guilan University of Medical Sciences, Rasht, Iran

² Assistant Professor, Department of Oral and Maxillofacial Surgery, Dental School, Guilan University of Medical Sciences, Rasht, Iran

³ Assistant Professor, Department of Orthodontics, Dental School, Guilan University of Medical Sciences, Rasht, Iran

⁴ Dentist, Private Practice

⁵ Nuclear Medicine, Private Practice

Abstract:

Statement of problem: Condylar hyperplasia of the mandible is a self limiting abnormality which can cause facial asymmetry, temporomandibular joint (TMJ) dysfunction and esthetic problems. Treatment planning is based on the results of isotope scanning, clinical findings and patient age. Single photon emission tomography (SPECT) is considered to be a sensitive method in the calculation of condylar uptake differences.

Purpose: The aim of this study was to determine the growth activity occurring in the mandibular condyles, and to devise an index of side-to-side differences in condylar activity in different individuals.

Material and Methods: 38 patients, with an age range of 13 to 34 years, undergoing skeletal scintigraphy for a variety of conditions, were chosen for this study. 25 mci TC-99 was injected to all subjects in order to assess the difference between right (Rt) and left (Lt) condylar uptake percentage and to calculate the Lt to Rt condylar uptake ratio. The normal index was determined.

Results: The maximum amount of difference between the uptake of Rt and Lt condyles was 6.2 percent (Lt side and Rt side were 53.1 % and 46.9 %, respectively) in the male patients and 5.7 percent in the female patients (Lt side and Rt side were 52.85 % and 47.15 %, respectively). The condylar activity difference and ratio of Lt to Rt condylar uptakes did not show a significant difference between the male and female groups.

Conclusion: The difference between the growth activity of RT and LT normal TMJs was less than 6.2 percent.

Key words: Mandibular condyle; Radionuclide imaging; Tomography

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✉ Corresponding author:

Zahra Dalili, Department of Oral and Maxillofacial Radiology, Dental School, Guilan University of Medical Sciences, Imam Khomeini street, Rasht, Iran
zahradalili@yahoo.com

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INTRODUCTION

Condylar hyperplasia of the mandible is a pathological state of development that can lead to facial asymmetry, mandibular deviation, malocclusion and articular dysfunction. This abnormality is important in dentistry due to induction of lateral open bite, midline shift,

prognathism, TMJ dysfunction and mal-occlusion [1-4]. It usually occurs between 10 to 30 years of age especially in the late teens after the adolescent growth spurt and rarely before 10 years or after 40 years [1,5,6]. There is no sex predilection but some studies have shown that it is more common in females [7-

9]. In this self-limiting deformity, active growth can cease at any time or may continue for many years and produce severe deformity [6]. The resulting abnormality in a young patient usually is condylar enlargement and ramous lengthening on the affected side [5]. In treatment planning for patients with unilateral condylar hyperplasia, it is very important to differentiate active phases from inactive [10]. When growth stops, a corrective osteotomy can be performed. In the case of persistent growth and progressive facial asymmetry, the growth center should be removed by condylectomy [11]. In the active "hot" condyle, definitive treatment can be delayed until the beginning of the "burnt out" phase [12].

Bone scintigraphy has been used in the diagnosis and treatment planning of mandibular condylar hyperplasia for many years [11]. This imaging modality has the ability to dynamic detection of abnormalities at an earlier stage before morphological changes are evident [13].

Bone Single Photon Emission Tomography (SPECT) scans give us a more sensitive and accurate idea of bone activity in the condyles of growing and non-growing patients. Quantitative bone SPECT scan is effective in the calculation of condylar uptake differences [14]. Difference of activity between the normal and abnormal condyles can be assessed by bone scans which reflect the relative growth rates at the time of investigation but do not reveal how long it will continue [15].

An analyzing method reflecting the dynamics of facial growth would be a valuable diagnostic tool in the work-up of patients with asymmetric deformities. The present study was designed to determine the difference of radioisotope uptake between right and left condyles in normal patients using bone SPECT scan. It is noteworthy that "normal index" may be different in various populations. Considering that a new index can be helpful in the

diagnosis of normal from abnormal cases, the current study attempted to define this index for an Iranian population.

MATERIALS AND METHODS

Thirty-eight patients (19 males, 19 females) without facial asymmetry who were undergoing TC-99m-MDP scintigraphy for a variety of conditions were included in this study. Written consents for quantitative assessment of TMJs and permission for taking panoramic radiographs were obtained from all subjects after explaining that the radiation dose is dependent on the injected isotope and not on the method of scanning. Panoramic views were used for ruling out gross abnormal radiographic findings of the condylar heads.

All patients, ranging from 13 to 34 years of age, had normal findings in routine TMJ examination.

Planar and SPECT images were carried out 3 hours after injection of 25 mci TC-99 m using a single head Genesys (ADAC Philips, Netherlands) SPECT system in all cases. The SPECT system collected data over 360° in a spherical field of rotation, using a 128 × 128 matrix, 64 frames at 30 seconds/frame.

Coronal views were reconstructed from axial images and were summated in the form of a composite image. Regions of interest were drawn around each TMJ, which was easily identified as a localized area of prominent uptake. The counts were noted within this area and the relative uptake calculated by the following formula:

$$\text{uptake in the Rt condyle} = \frac{\text{RightCounts}}{\text{Left} + \text{RightCounts}} \times 100$$

The difference of activity between Rt and Lt TMJs and the ratio of left to right condylar uptake was also calculated. ANOVA and *t*-test were used for statistical analysis of collected data by SPSS software.

RESULT

The maximum difference between the

Table I: Side-to-side differences in condylar activities in each sex groups and different age groups.

Variables	Numbers	Difference of activity	95% Confidence interval	P-value	
Sex	Female	19	2.76	1.89-3.62	0.85*
	Male	19	2.65	1.86-3.44	
Age ranges	10-20	22	2.66	2.02-3.29	0.21**
	20-30	12	2.34	1.05-3.64	
	>30	4	4.05	1.30-6.81	

*: t-test, **: ANOVA

percentage uptake of right and left condyles in male patients was 6.2%, Lt side and Rt side were 53.1% and 46.9% respectively. However, in the female patients it was 5.7%; Lt side and Rt side were 52.85% and 47.15% respectively. The mean difference was 2.7% with the standard deviation (SD) of 1.69.

Tables I summarized Side-to-side differences in condylar activities regarding sex and different age groups. According to t-test analysis, no significant difference was found between the female and male groups regarding percentage counts (p = 0.85).

Table II illustrates left to right condylar uptake ratio in each sex and age group. The results demonstrated a normal range of 89-113% for left to right condylar uptake ratio with the mean (SD) of 100% (6.4).

DISCUSSION

Activity in the condylar heads is not equal in patients with normal TMJs [16]. It is assumed that in the absence of any other pathological process, the difference in activity is due to variations in growth and remodeling within the condylar tissues and/or methodological causes. Our finding of a maximum side-to-side dif-

ference in uptake of isotope (6 percent) is similar to the 6 and 10 percent differences reported by other investigators [14,16]. Pogrel et al [16] demonstrated that the side-to-side variations in uptake were always less than 10 % and Hodder et al[14] reported a difference of 6 % between two normal condyles, Right side and left side were 47 % and 53 %, respectively. The normal range of Lt to Rt side activity ratio in our study was in accordance with the findings of Robinson et al [15] who found 12 percent variation in activity between the two sides. The present study determined a comparable index for condylar activity with similar studies, and therefore, ruled out the effect of genetic background on the amount of condylar activity differences.

The interfering variable on condylar uptake was eliminated by a thorough examination of the TMJ and radiographic evaluation during case selection. Summation of coronal images for calculation of condylar uptake reduced the variability in selecting the proper cut for calculation of counts per pixel.

Two factors may influence our assumptions of condylar activity; first, the mediolateral width of the condyles; a joint with an increased

Table II: Left to Right condylar uptake ratio in each sex group and different age groups.

Variables	Numbers	Ratio (Lt/Rt)	95% Confidence interval	P-value	
Sex	Female	19	99	96-103	0.34
	Male	19	101	98-104	
Age ranges	10-20	22	101	98-103	0.12
	20-30	12	98	94-102	
	>30	4	106	93-118	

width will result in an increased count per pixel, regardless of the fact that the joint may have normal activity. The second factor was an important element in the determination of a normal index is the exclusion of patients in the "burnt out" phase (deformity does not progress with time) because in this phase, the side-to-side uptake of the isotope can be in a normal range; thus in calculation of this difference, clinical status must be considered.

SPECT bone scintigraphy has provided an accurate and quantifiable assessment of the relative activity in the mandibular condyles. Determination of a normal index of growth activity in the condylar heads allows for the diagnosis of an abnormal situation to be made early and the appropriate treatment to be initiated.

CONCLUSION

Right-left differences in isotope uptake of 6 to 12 percent appear to be normal. This quantitative criterion can be used in the diagnosis of patients with unilateral condylar hyperplasia, and to distinguish an active phase from an inactive phase of unilateral condylar hyperplasia.

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