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Mandibular bone density and permanent root development variations in children with Autism Spectrum Disorders

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Abstract:
Background*: Autistic children were the greatest challenge for pediatric dentists due to their complex behavior and oral manifestations.*
Aim*: the present study was designed to compare mandibular bone density and permanent root development variations in autistic patient with healthy group.*
Materials and methods*: The study was carried out on one hundred children of both sexes aged from six to eight years old, selected from the Child and Adolescent Psychiatry outpatient clinic of Psychiatry and Neurology Center, Faculty of Medicine, Tanta University and Pedodontic clinic, Faculty of Dentistry, Tanta University.*
The selected children were divided into two groups. Group I included fifty children had been previously diagnosed with autism spectrum disorders and group II included fifty healthy children. Cone beam computed tomography were taken for both groups using lead apron to avoid any hazards. The Simplant program was used to measure root length, apical root width and the needed gap for root closure for permanent mandibular central incisors and permanent first molars. In addition, mandibular bone density in Hounsfield Units (HU) at the symphysis and body of the mandible were evaluated.
Results*: Results of the present study showed statistically significant shorter mean root length of both permanent central incisor and distal root of first molar in autism group than that of normal group. While there was no statistically significant difference between both groups for the mean mesial root of first molar. However, the mean mesial root length was slightly longer in group II than group I.*
Conclusion*: autistic children have significant delayed dental development and lower mandibular radio-density compared to normal children.*
KEYWORDS*: Autism spectrum disorders-Dental development-mandibular radio-density.*

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I. Introduction

Autism spectrum disorders (ASD) are a group of neurodevelopmental disorders characterized by impaired social interactions, verbal and non-verbal communication, repetitive and restrictive behavior, and learning disability, self-control with unusual play, interests, activities and poor eye contact.[1,2]

ASD are more common in males than females, with males being 3-4 times more likely to develop an ASD than females. [3] There is no medical or genetic test for Autism. Diagnosis is solely on clinical diagnostic testing.[4]

The causative factors of autism are unknown. They are complex in nature and involve neurobiological factors in brain. Combination of genetic factors, family history, environmental influences, prenatal and post-natal defects, infection, drug and chemical exposure may contribute to the development of autism.[5,6]

Autism is not an illness or disease and can't be cured. It occurs in all ethnic, racial, and economic groups. It can be diagnosed at any age, but symptoms generally appear in the first two years of life.[7]

There are clinical manifestations which are relevant for children with classic autism as epilepsy, over 30% have experienced seizures by adolescence, depression/Anxiety, attention deficit hyperactivity disorder (ADHD), obsessive compulsive disorder (OCD), schizophrenia and migraines.[8,9]

Oral manifestation relevant for autistic patients are: bruxism (20-25%), tongue thrusting, non-nutritive chewing, self-injury (picking at gingiva, biting lips) creating ulcerations, tooth decay, xerostomia, erosion (many parents report regurgitation, medical consult may be indicated), poor oral hygiene.[10]

Children with ASD and seizures may be treated with anticonvulsant medications that impact vitamin D metabolism and bone mineral density (BMD) also they have low exercise rates that affect bone development and so on bone density.[11]

Researchers believe that children with ASD were 9 months younger than typically developing control patient on average. BMD is lower in ASD than control group in lumbar spine, total hip and femoral neck.[12]

Autistic children accessed delayed dental development and had lower mandibular radio-density compared to healthy children. [13]

II. Materials and Methods

Study design:
This study was carried out as a case control design.

Study setting:
The study was conducted at pedodontic clinic, Faculty of Dentistry, Tanta University and outpatient clinic in psychiatry Department, Faculty of medicine, Tanta University.

Sample selection:
The study sample consisted of one hundred children aged from six to eight years old, selected from the Child and Adolescent Psychiatry outpatient clinic of Psychiatry and Neurology Center Tanta University and Pedodontic clinic, Faculty of Dentistry, Tanta University.

Group assignment:
Group I: (study group) fifty children (14 boys and 36 girls) had been previously diagnosed with autism spectrum disorders using Childhood Autism Rating Scale (CARS)[4,14] attended the Child and Adolescent Psychiatry outpatient clinic of Psychiatry and Neurology Center, Tanta University.

Group II: (positive control group) consisted of fifty healthy children (39 boys and 11 girls) matching the same age were randomly selected from Pedodontic clinic, Faculty of Dentistry, Tanta University.

Treatment plan was explained to the parent or guardian and a written consent was obtained from the parents/guardian of the children before any clinical or radiographic procedure

Inclusion criteria:
The children included in the present study were chosen to fulfill the following inclusion criteria:

- Apparently healthy children (except for ASD in the study group) free from any systemic diseases that could affect tooth development.
- Absence of congenitally missing permanent teeth.
- Bilateral eruption of permanent mandibular central incisors and permanent first molars.
- Relatively co-operative children.

Cone beam computed tomography were taken for both groups using lead apron to avoid any hazards. The Simplant program was used in both groups to measure the following criteria:

- Root length, apical root width and the needed gap for root closure for permanent mandibular central incisors and permanent first molars.
- Mandibular bone density in Hounsfield Units (HU) at the symphysis and body of the mandible (near the right angle of the mandible).

Root closure index to access the stage of root closure [111] according to the following:

- 1/3rd root completed.
- 2/3rds root completed.
- Root completed with open apex.
- Apical foramen closed.

The cone beam images for both the autism and control groups were analyzed using the Simplant program 17.09[*] software. The images were investigated for the following:

- In both groups the length of the lower right central incisors was measured in mms from cemento enamel junction (CEJ) to root apex using the (Measure distance) tool from the coronal view.
- In both groups the width of the lower right central incisors was measured in mms from apical canal width using the (Measure distance) tool from the coronal view.
- The mean bone density at the symphysis in Hounsfield units was measured using the (Measure density in ellipse tool) from the coronal view.
- The mean bone density near the right angle of the mandible was measured in Hounsfield units using the Measure density in ellipse tool) from the sagittal view.
- The length and width of the mesial and distal roots of the lower right first molar were measured using the (Measure distance) tool in mms from the sagittal view

III. Results

a: Root length:

The mean root length of lower right central incisor and distal root of lower right first molar in autistic group was shorter than that in normal group table (1) figure (4) and the difference between both groups was statistically significant. However, the mean mesial root length was slightly longer in group II than group I and the difference between both groups was not statistically significant.

Table (1): Comparison between group I & II in relation to the mean root length of lower right central incisor and lower right first molar.

Root length	Group I	Group II	T	p-value
Central incisor	**5.87±0.53**	**7.33±1.39**	**6.878**	**0.000****
First molar(Mesial root)	**6.19±0.69**	**6.55±0.19**	**1.115**	**0.297**
First molar(Distal root)	**7.29±0.57**	**8.67±0.93**	**8.907**	**0.000****

(*) p-value is significant at≤ 0.05 & (**) is highly significant.

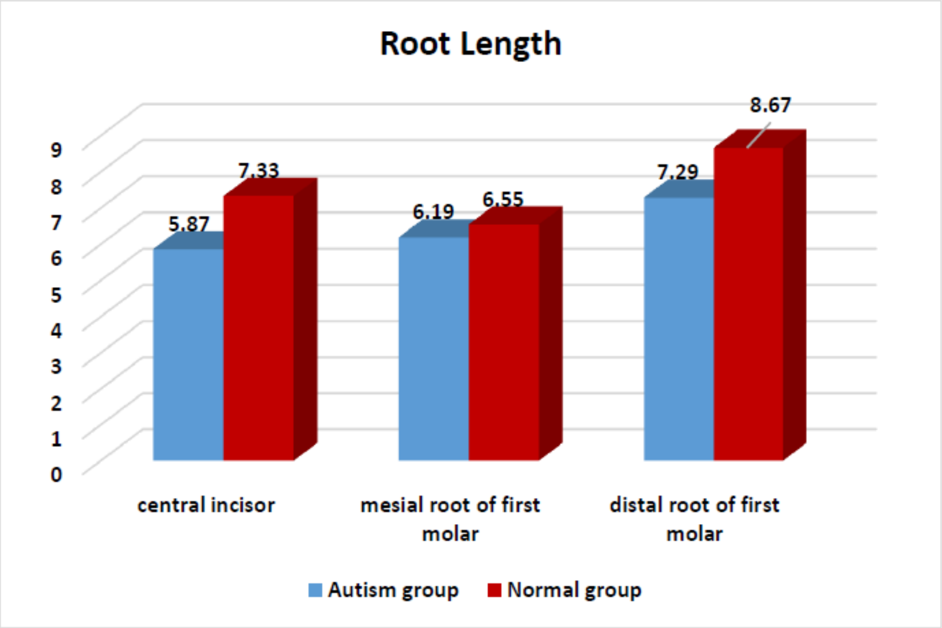

Figure (4): Root length of lower right central incisor and lower right first molar in both groups.

b: Apical root width:

The mean apical root width of lower right central incisor and lower right first molar in autism group was wider than that in normal group as shown in table (2), and figure (5). The difference between both groups was statistically highly significant for central incisor and statistically significant for mesial root. There was no statistically significant difference between both groups for distal root. However distal root width was wider in group I than group II.

Table (2): Comparison of the mean apical root width of lower right central incisor and lower right first molar in both groups.

Apical width	Autism group	Normal group	t	p-value
Central incisor	**2.96±0.45**	**2.53±0.53**	**4.349**	**0.000****
First molar(Mesial root)	**2.45±0.37**	**1.57±0.27**	**4.334**	**0.002***
First molar (Distal root)	**3.91±1.06**	**3.58±0.67**	**1.861**	**0.066**

(*) p-value is significant at≤ 0.05 & (**) is highly significant.

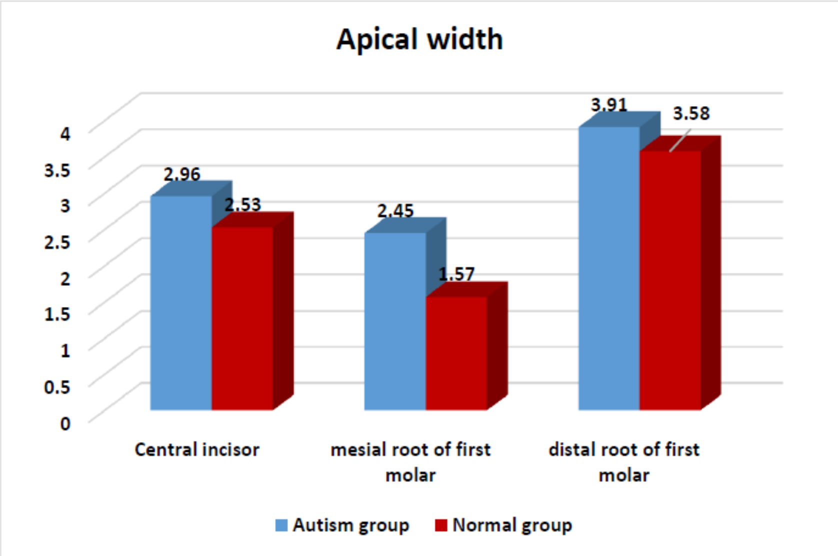

Figure (V-5): Apical width of lower right central incisor and lower right first molar in both groups.

c: Bone density:

The mean bone density at the symphysis and near the right angle of the mandible in Hounsfield units was lower in autism group than that in control group as shown in table (3) and figure (6). The difference between both groups was statistically highly significant at the right angle of the mandible and statistically significant at symphysis.

Table (3): Comparison in mean bone density at the Symphysis and near the right angle of the mandible between both groups.

Bone density	Autism group	Normal group	t	p-value
Symphysis	**1393.32±249.89**	**1619.04±479.24**	**2.953**	**0.004***
Right angle of mandible	**647.49±139.26**	**1079.94±493.27**	**5.966**	**0.000****

(*) p-value is significant at≤ 0.05 & (**) is highly significant.

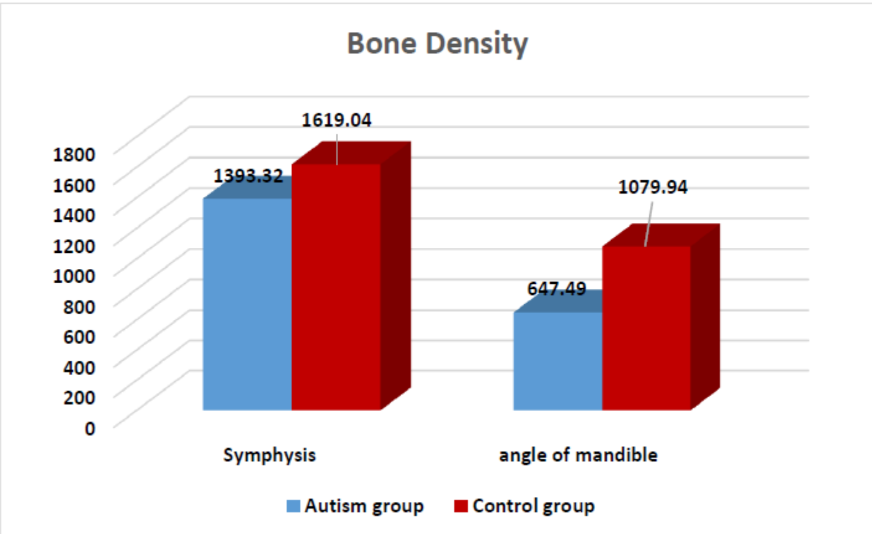

Figure (6): Bone density at the symphysis and near the right angle of mandible in both groups.

D-Root closure:

The mean needed gap for root closure for permanent mandibular right central incisors and lower right first molar was smaller in control group than that in autism group. The difference between both groups was statistically significant. Table (4,5) and figure (7,8).

Table (4): Comparison in mean root closure of central incisor between both groups.

Root Closure		1/3rd root Completed	2/3rd root Completed	Root Completed, apex open	Apical foramen closed	Z	p-value
Central incisor	Group I	9(18%)	12(24%)	29(58%)	0(0%)	3.760	0.000**
	Group II	0(0%)	30(60%)	13(26%)	7(14%)		

(*) p-value is significant at≤ 0.05 & (**) is highly significant.

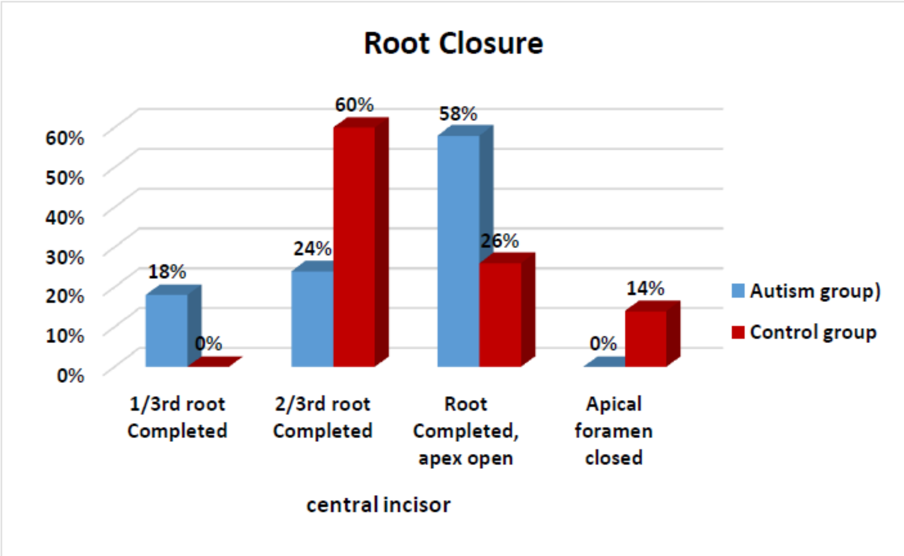

Figure (7): Root closure of lower right central incisor in both groups.

Table (5): Comparison in mean root closure of first molar between both groups.

Root Closure		1/3rd root Completed	2/3rd root Completed	Root Completed, apex open	Apical foramen closed	Z	p-value
First molar	Group I	0(0%)	10(20%)	30(60%)	10(20%)	5.653	0.000**
	Group II	0(0%)	0(0%)	31(62%)	19(38%)		

(*) p-value is significant at≤ 0.05 & (**) is highly significant.

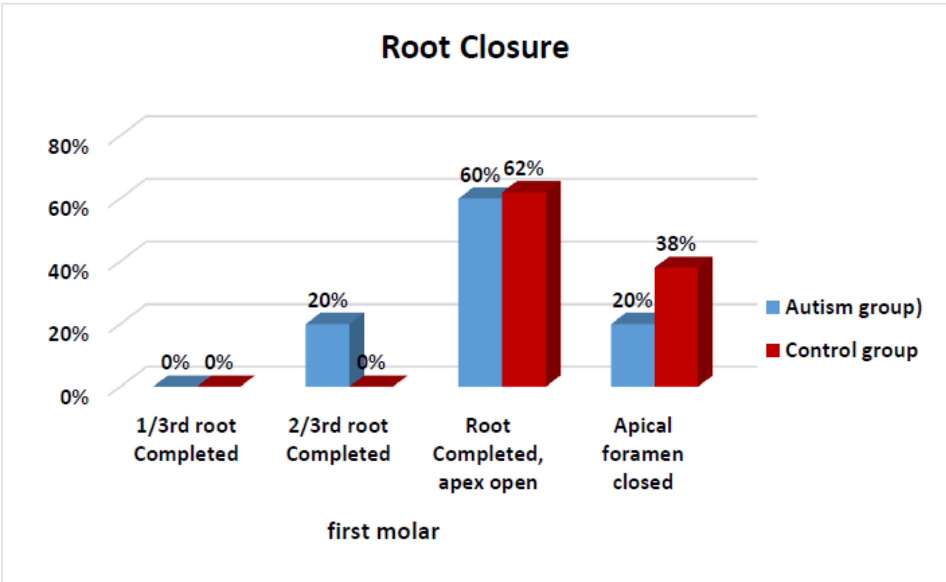

Figure (8): Root closure of lower right first molar in both groups.

IV. Discussion

Autism is one of the most commonly known puzzling developmental disorders.[15] Recently, awareness of autism has grown dramatically and the number of children diagnosed with autism spectrum disorder is rising. This rise might be due to better detection and reporting or a real increase in the number of cases, or both. Early diagnosis can offer major benefits and relief throughout their lives. [16]

Autistic children were the greatest challenge for pediatric dentists due to their complex behavior and oral manifestations.[10] Sometimes, children with ASD are treated using unusually restricted diet including: gluten-free casein-free (GFCF) diets, and lactose-free diets. GFCF diets might limit calcium or vitamin D intake so differences in bone thickness are magnified. They also may be treated with anticonvulsant medications that impact vitamin D metabolism and bone mineral density. [11]

So, the present study was designed to compare mandibular bone density and permanent root development variations in autistic patient with healthy group.

The age of selected sample was between 6 to 8 years to include eruption of permanent lower central incisor and permanent first molar.

It was impossible to place intra oral film for autistic children, and Conventional panoramic radiographs were relatively inaccurate and overestimating the lengths by 29%. while CBCT underestimated the lengths by 4 %. [17]

Hence, the choice of cone beam radiograph, which in addition to significantly reducing radiation dose to the child in comparison to conventional radiography, less children cooperation was required, therefore, it was easier to perform for children with autism.

The effective dose for dental panoramic radiograph is 26 µSV, and the effective dose of full – mouth series reaches to 388 µSV whereas the effective dose for sectional cone beam computed tomography for the area of interest is 5 to 38. 3 µSV. [18,19]

Using lead apron to avoid any hazards, Cone beam computed tomography were done for both groups with soft Simplant program to measure root length, apical root width and the needed gap for root closure for permanent mandibular central incisors and permanent first molars and mandibular bone density in Hounsfield Units (HU) at the symphysis and body of the mandible.

Results of the present study showed statistically significant shorter mean root length of both permanent central incisor and distal root of first molar in autism group than that of normal group. While there was no statistically significant difference between both groups for the mean mesial root of first molar. However, the mean mesial root length was slightly longer in group II than group I.

These results are in accordance with ElBaz G 2017 [13] who reported that: the Autistic group showed statistically significant shorter mean root length values than the control group in both mesial and distal root of lower first molar. But there was no statistically significant difference between mean root length values in the two groups in lower central incisor. The difference in results may be due to type of x ray used (digital panoramic radiographs) and sample size.

This may be due to delayed tooth eruption in children with ASDs due to phenytoin-induced gingival hyperplasia. Phenytoin is a commonly prescribed drug for people with ASDs. [13,20]

Regarding the mean apical root width; results of the present study showed statistically significant wider mean apical root width of lower right central incisor and mesial root of lower right first molar in autism group than that in normal group. There was no statistically significant difference between both groups for distal root. However, the mean distal root width was wider in group I than group II.

These results agreed with ElBaz G 2017 [13] who reported that Autistic group showed statistically significant wider mean apical width values than control group in both lower permanent central incisor and first molar.

On the other hand, the mean bone density at the symphysis and near the right angle of mandible was lower in autism group than that in control group. The difference between both groups was statistically significant.

These results agreed with, ElBaz G 2017 [13] who reported that autistic group showed statistically significant lower mean radio-density values than the control group at both, the angle of the mandible and at the symphyseal area using digital panoramic radiographs.

On the other hand, this result agreed with, Hediger et al 2008 [21], who reported decreased cortical bone thickness using hand-wrist radiographs in children with autism.

Also the results of the present study are in accordance with, Neumeyer et al 2013 [11], who found that boys with ASDs have lower bone density than controls pubertal boys with ASDs using dual energy X-ray absorptiometry (DXA). The difference between both groups was statistically significant at the spine, hip and femoral neck.

In accordance with the present study, in another research Neumeyer Ann M 2018 [12], reported that autistic patient were 9 months younger than typically developing control patient on average using dual energy

X-ray. BMD is lower in ASD than control group at lumbar spine, total hip and femoral neck. The difference between both groups was statistically significant.

The main limitations of our study were the relatively small number of previous studies available on the radiographic representation of dental development and jaw density in children with autism

V. Conclusion:

Autistic children have significant delayed dental development and lower mandibular radio-density compared to normal children

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