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BONE DENSITY ASSESSMENT FOLLOWING STEM CELLS THERAPY /CORTICOTOMY IN THE TREATMENT OF MILD DENTOSKELETAL CLASS III MALOCCLUSION; CONE BEAM TOMOGRAPHIC STUDY

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ABSTRACT

Objectives: Assessment of bone density following stem cells therapy /corticotomy in the treatment of mild dentoskeletal class III malocclusion through cone beam tomographic analysis. **Patient and methods:** CBCT scan was done at T1in the beginning of the study and T2 after 6 months. Two groups of randomly selected patient, group I(6males and 4 females with age average of (20years 10months) in which patients were treated using corticotomy facilitated orthodontics with incorporation of stem cells, while in group II(5 males and 5 females with age average of (19 years 8months) the patients were treated using corticotomy facilitated orthodontics. **Results:** In both groups; there was no statistically significant change in bone density after treatment.

INTRODUCTION

The quality or density of available bone influences the clinical success of dental procedures. Cone beam computed tomography CBCT has been examined whether it can assess oral bone mineral density BMD in patient. Hounsfield units HU is an expression allows precise three-dimensional evaluation of anatomic structures and direct measurement of bone density through assessment of gray scale of the image [(1)] .

The stem cell therapy is said to be the gate for new era of treatment through which many horizons will be facts not only hopes .In the human body there are many types of stem cells of multiple sources such as bone marrow, adipose tissues, and recently oral tissues which could be easily collected, isolated, subjected to proliferation and to be re-injected into the body to act as repair cells for certain tissue or organ.[(2)]

Stem cells are defined as primitive cells with the ability to divide to produce fully functional mature cells capable of specific function in tissue. Generally stem cells have the ability to divide to give rise both daughter cells and more specialized function cells.[(3-5)]

Accelerated osteogenic orthodontics has been proposed as a technique to facilitate tooth movement by a combination of corticotomy and orthodontic/ orthopedic forces. The biologic basis of accelerated osteogenic orthodontics has been suggested to be mediated by a regional acceleratory phenomenon.[(6,7)]

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The treatment modalities for correcting Class III malocclusions should be differentially used depending on the position of skeletal and dental discrepancies as well as the status of the skeletal growth of the patient.[8]

Cone-beam imaging is said to be suitable for the craniofacial area, in particular for evaluating bone and dental hard tissue. As these units have been custom designed for this region, unlike conventional computed tomography CT, the software has been specifically produced to simplify obtaining the most useful views using pre-set parameters. In addition, most have been developed to work with other propriety maxillofacial imaging software, compared to conventional CT, there are a number of significant advantages:[9] In orthodontics, 3D imaging can help to unravel the complexity of dental and skeletal malocclusions and improve diagnosis and treatment planning in specific case types.[6,10]

PATIENTS AND METHODS

The present study was conducted to evaluate bone density following stem cells therapy /corticotomy in the treatment of mild dentoskeletal class III malocclusion through cone beam tomographic analysis. The current study was conducted on a total sample of twenty adult orthodontic patients (11 males and 9 females) presented with mild dentoskeletal class III malocclusion with age ranged from 18-25 years. The sample was screened, selected, allocated then distributed randomly from patients seeking orthodontic treatment in orthodontic clinic, Orthodontic Department, Faculty of Dental Medicine, Al- Azhar University, Cairo (Boys), Egypt.

The inclusion criteria:[11-13]

All patients participated in the current study have met the following criteria: Mild dentoskeletal class III malocclusion due to maxillary deficiency, and cephalometric reading of SNA angle ranging from 76° to 79°and ANB angle ranging from -2° to 0°,Good oral hygiene, All permanent teeth are fully erupted ,(impacted third molar was present), free from any craniofacial anomalies, No systemic disorders and/or medications that might interfere with orthodontic treatment and/or corticotomy.

The exclusion criteria:[14]

Previous orthodontic treatment, Congenitally missing or extracted permanent teeth, Patients having skeletal class III malocclusion due to mandibular prognathism and normal maxilla, Uncooperative or externally motivated patient. (Patients were assessed for cooperation and motivation prior to inclusion), Mentally or physically handicapped patients.

The study Ethical approval:

Prior to commencing the study, the protocol of the work was ethically approved from the Ethics Committee ,Quality Education Assurance Unit , Faculty of Medicine ,AL-Azhar University, Nasr City, Cairo- Egypt, and registration was number (Orthod._5 Med. Research) dated in 10/11/2013.

The patients were distributed randomly into two equal groups according to the incorporation of stem cells concomitant to corticotomy . Group I in which the stem cells therapy was incorporated with corticotomy included 6males and 4 females with age average of (20years 10months).Stem cells were of dental origin, collected from teeth extracted for orthodontic purpose. While in Group II corticotomy was carried on only and included 5 males and 5 females with age average of (19years 8months). Corticotomy procedure for both groups included Nano-hydroxy apatite bone grafting material placement. :[12,13,15,16–21]

There was no discontinuation or drop out of anyone of the patients and after finishing the research protocol after 6 months and all patients were undergone the comprehensive orthodontic treatment completion.

Statistically, Numerical data were explored for normality by checking the data distribution and using Kolmogorov-Smirnov and Shapiro-Wilk tests. bone density measurements data showed non-normal (non-parametric) distribution.

Cone beam computed tomographic(CBCT) scan:

A particular CBCT machine* was used in this study. CBCT analysis was done through a specialized radiographic center** and patients data were signed by secret to avoid operator bias. After acquisition, data were exported and transferred into DICOM format and downloaded via a Compact Disk CD to a personal computer for linear measurements, where in vivo Dental*** software was utilized. Serial of steps were followed to standardize the measurements in all scans.

The First step; superimposition :[22,23]

The set of Dicom data of the preoperative scan was loaded into the software, and then the set of the postoperative scan of the same patient were loaded prior to superimposition According to variation in positioning of both scans; a second adjustment was needed to ensure perfect superimposition, hence guaranteeing measuring linear**.**

The Second step; Orientation :[22,23]

Certain planes were to be assigned as references, according to which the measurements would be taken. After completion of superimposition, the two scans preoperative and postoperative were handled as one unit and moved in the same sequence. Orientation of the whole volume was made to ensure that the orthogonal reference lines (axial, coronal and sagittal) were following certain planes.

Bone density measurements:

At the axial level of anterior teeth root apices, the density of the palatal bone was measured using Density measurement tool in the software, where the mean of the Grayscale value is calculated for the interdental bone at the preoperative and postoperative scans in a surface area[24] of 10 mm^2. Figure (1)

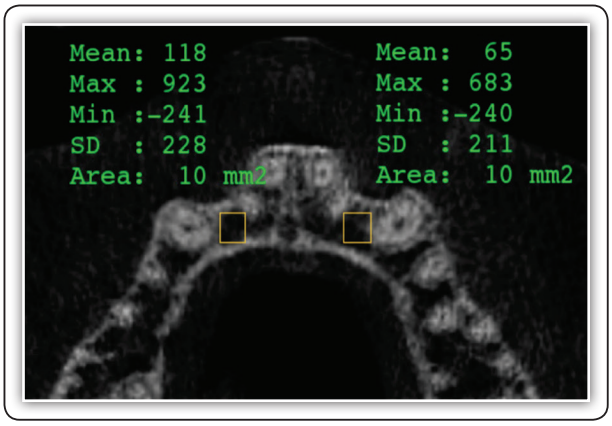

FIG (1) Bone Density measurements

RESULTS

The study was started at time T1 and completed after 6 months at time T2. For each group the results at T2 was compared to the preoperative initial data at T1.Descriptive statistics of bone density are presented in table (1).

Changes after treatment within each group

In both groups; there was no statistically significant change in bone density after treatment**.** Line chart representing changes in mean bone density after treatment Figure (2).

Comparison between the two groups:

There was no statistically significant difference between bone density in the two groups either before treatment or after treatment.

There was a statistically significant difference between changes in bone density values in the two groups. Group I showed an increase in bone density while Group II showed a decrease**.**

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**Denta Scan Radiographic Center ,Maadi. Cairo. Egypt.

*** In vivo 5/Anatomage. San Jose, CA. USA.

TABLE (1): Descriptive statistics of bone density in the two groups

Group	Time	Mean	SD	Median	Minimum	Maximum	95% CI	
							Lower bound	Upper bound
Group I	Before treatment	262.5	88.2	254.3	154.5	448.0	199.4	325.5
	After treatment	297.9	114.4	279.8	163.0	512.0	216.0	379.7
	Change	35.4	125.6	-5.0	-59.0	357.5	-54.5	125.3
Group II	Before treatment	326.2	190.2	338.0	91.5	623.0	180.0	472.4
	After treatment	307.5	179.0	226.5	98.5	613.5	169.9	445.1
	Change	-18.7	164.4	-44.0	-199.0	299.0	-145.1	107.6

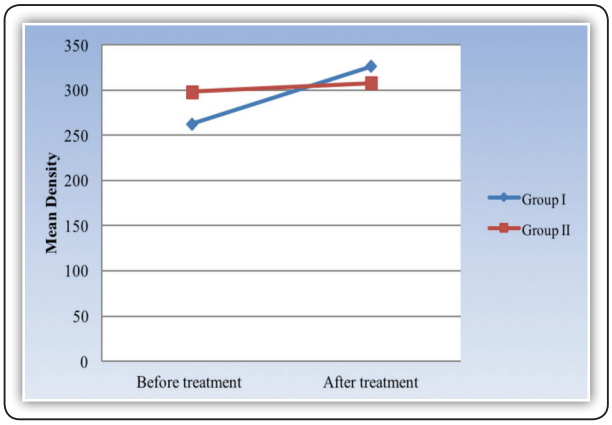

FIG (2) Line chart representing changes in mean bone density after treatment.

DISCUSSION

The current study was to Assess bone density following stem cells therapy /corticotomy in the treatment of mild dentoskeletal class III malocclusion through cone beam tomographic analysis.

In other study a quantitative evaluation of the cortical bone densities of the maxillary and mandibular alveolar processes in adults with different vertical facial types was done using cone-beam computed tomography CBCT images. The selected sample was 142 adult females aged between 20 and 45 years were classified into hypo divergent, norm divergent, and hyper divergent groups on the basis of linear and angular S-N/Go-Me measurements. The cortical bone densities in Hounsfield units at maxillary and mandibular interdental sites from the distal aspect of the canine to the mesial aspect of the second molar were measured on the images. The study concluded that adults with the hyper divergent facial type tend to have less-dense buccal cortical bone in the maxillary and mandibular alveolar processes. Clinicians should be aware of the variability of cortical bone densities at mini-implant placement sites.[25]

The densities of the maxillary and mandibular buccal cortical plates and maxillary palatal cortical plate were measured at 4 interdental sites: between the canine and the first premolar ,between the first and second premolars, between the second premolar and the first molar, and between the first and second molars. The lingual cortical plate in the mandible was measured. The main value of bone density was measured buccally and lingually at the same levels (cervical, middle, and apical). Bone density was measured in Hounsfield units HU. The alveolar bone was classified into the following categories: D1, compact cortical bone, ≥ 1200 HU; D2, crestal cortical bone and coarse trabecular bone underneath, 700 to 1200 HU; D3, porous crestal layer of cortical

bone and fine trabecular bone, 350 to 700 HU, and D4, fine trabecular bone, 100 to 350 HU. The registration of the various tissue types is based on differences in absorbed radiation.[26]Clinical cone beam computed tomography CBCT has been examined whether it can assess oral bone mineral density BMD in patient. It has been indicated that CBCT has disadvantages of higher noise and lower contrast than conventional medical computed tomography CT systems.[27]

Bone density was measured at the alveolar and basal bone levels in Hounsfield units HU using bone mineral density software incorporated in the CT machine The examiner measured the bone density of each area three times on each of the axial images for both right and left sides. To analyze differences of the bone density at the incisor, canine, premolar, molar, and retromolar or tuberosity areas in the maxilla and mandible. The study stated that the density of the cortical bone was greater in the mandible than in the maxilla and showed a progressive increase from the incisor to the retromolar area.[28]

Also cancellous bone density in the alveolar bone was evaluated by cone-beam computed tomography. The purpose of the study was to assess the bone quality affecting the initial stability of dental implants.[29]

According to the studies available to date, it may be concluded that CBCT could be considered in the examination of choice for the determination of mineral density of osseous and soft tissues, especially when values obtained are compared with predetermined standard values. Comparisons between symmetrically positioned structures inside the field of view FOV and in relation to the exomass of the object, as with the right and left sides of the skull, seem to be viable because the effects on the gray values in the regions of interest are the same, so cone beam computed tomography CBCT may be useful regarding bone quality evaluation.[30,31]

CONCLUSION

The current study was to Assess bone density following stem cells therapy /corticotomy in the treatment of mild dentoskeletal class III malocclusion through cone beam tomographic analysis. The study concluded that In both groups; there was no statistically significant change in bone density after treatment .

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