

# A STUDY OF INTERPRETING BONE DENSITY ON PANORAMIC X-RAYS

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This study was conducted on 47 patients selected for dental-implant treatment. The purpose was to evaluate as precisely as possible the bone density on panoramic X-rays. The subjects selected varied by sex, age, edentulous areas, constitutional types, and local conditions.

On panoramic X-rays a preliminary evaluation of bone density can be done, within limitations, based on the opacity of bone structures and on localizing inter-trabecular spaces. In order to correlate the direct observations on panoramic X-ray with bone density measured on Computed Tomography, CT was performed on several patients. Bone densities evaluated on X-rays were then compared to those measured on CT.

The conclusion we reached was that bone density can be evaluated on panoramic X-rays if we consider the fact that there would always be bones of lower density.

*Key words:* Selection of patients; Panoramic X-ray; Bone density.

## MATERIALS AND METHODS

There were recruited 47 patients, selected from those who came to our clinic and wanted to benefit from dental implant treatment. All of them brought routine blood tests and a panoramic X-ray. All the patients had to undergo a general clinical examination and an attentive evaluation of their oral cavity. These clinical examinations are performed in order to exclude general or local diseases that could compromise the dental implant treatment.

Requested blood tests were: erythrocytes and white blood cells count, blood glucose, hepatic enzymes (SGOT– serum glutamic-oxaloacetic transaminase and S–GPT), creatinine, uric acid, urea, alkaline phosphatase, blood iron and erythrocytes sedimentation rate (ESR). Patients with altered blood tests were not included in the study.

While conducting the general clinical examination, we looked for diseases that could influence the patient's condition during the surgical intervention or that could make the cooperation with the patient difficult.

The general clinical examination was brief and it also included the patient's anamnesis based on their written statement.

Diseases that do not allow patients to undergo dental implant treatment are:

- A. Psychiatric disorders: all psychoses (even if treated), alcoholism, drug abuse and drug dependence.
- B. Neurological diseases.
- C. Cardiac diseases: heart failure (even if under treatment), arrhythmias, high blood pressure, previous myocardial infarction.
- D. Respiratory diseases: Chronic Obstructive Pulmonary Disease.
- E. Endocrine and metabolic diseases.
- F. Disorders of the immune system and allergies: major disorders and allergies of any kind.
- G. Diseases in the Oto-Rhino-Laryngology area: any inflammatory or infectious disorders.

Malignancies of any kind were also a criterion for selecting patients (those patients having malignancies were not included in our study).

We also considered “benign” psychological disorders and we did not include in the study patients that are difficult to cooperate with because of their behavioural disorders. Such examples are: exaggerated anxiety, aggressivity, paranoid or schizoid disorders etc.

We kept for our study only healthy, adequately behaving patients.

Oral cavity examination excluded from our study patients having one of the following: oral ulcerations, Herpes Simplex infections, perimaxillary infections, maxillary sinusitis, poor oral hygiene, other undiagnosed lesions of the oral cavity.

Imagistic diagnosis referred to performing and interpreting **the panoramic X-ray**. This is a mandatory evaluation before dental implant treatment (Misch). The panoramic X-ray offers a general view of the structures in the stomatological area of interest. Structures visible on a panoramic X-ray are: teeth and periodontal elements, teeth ridges, bone underneath the tooth ridge, anatomical “limits” – mandibular canal and the maxillary sinus, mental foramen and other structures that do not make the object of our study. Misch states that in 30% of the cases, the mandibular canal and the mental foramen cannot be clearly distinguished on a panoramic X-ray. In these situations, Computed Tomography is required.

**On the panoramic X-ray it can be done a preliminary, limited appreciation of the alveolar bone density, based on the opacity given by the bony structures and on identifying the intertrabecular spaces.**

Appreciation of bone density depends on the following:

- uniform X-ray technique, using the same parameters;
- mineralization of compact bone, which can sometimes hide the spongiouse bone transparency;
- subjectivism of the observer; it is related to the observer’s experience.

In spite of the above factors, preliminary bone quality can be appreciated, based on the panoramic X-ray appearance, correlated to the Minsch bone density classification:

- D1: dense, compact bone-anterior mandibular area;
- D2: porous compact bone, dense spongiouse bone-anterior and posterior mandibular areas, anterior maxillary area;

D3: thin, porous compact bone and thin (aerated) trabecular bone-anterior maxillary area and posterior maxillary and mandibular area;

D4: trabecular bone alone-posterior maxillary area.

According to Minsch, the most accurate imagistic method for exploring bone density is Computed Tomography. Based on the Hounsfield density units (HU) the condition of the alveolar process can be appreciated in any region, using the “spot” tomo-densitometry.

D1: over 1250 Hounsfield units (HU)

D2: over 850-1250 Hounsfield units (HU)

D1: over 350-850 Hounsfield units (HU)

D1: over 150-350 Hounsfield units (HU)

D1: less than 150 Hounsfield units (HU)-not suitable for dental implant treatment

**In our study, we suggest the following criterium of evaluation:**

D1: dense, opaque aspect, visible only in the frontal mandibular area;

D2: dense, opaque bone, which permits visualisation of small intertrabecular spaces;

D1: medium bone density, large intertrabecular spaces;

D1: radio-transparent bone with very large, visible intertrabecular spaces;

D1: radio transparent bone.

We intend to verify the accuracy of this method.

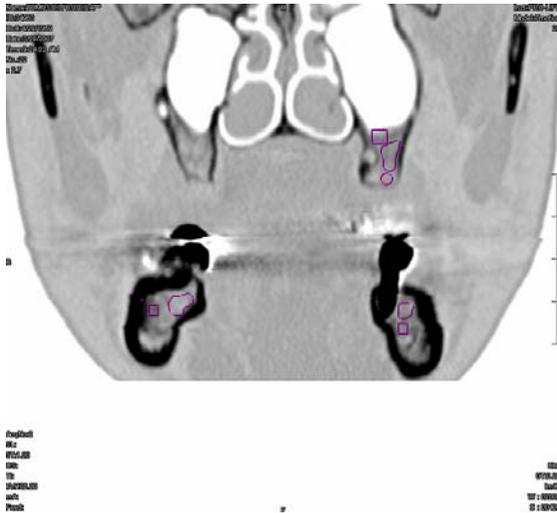
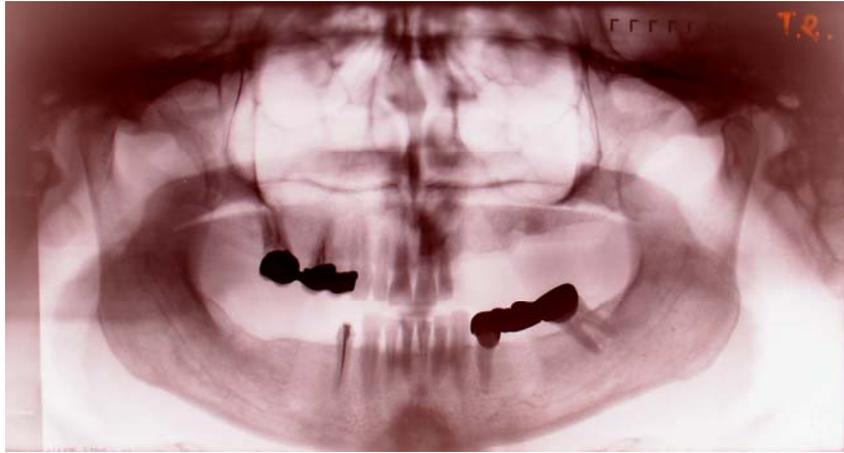
For easier interpretation of the X-rays, we inverted colours. Every X-ray presented in this study contains a comment (explanation).

**In order to correlate the direct X-ray observations with the bone density measured in Computed Tomography, we performed dental CT to some of the patients. We then compared bone densities evaluated on the X-rays to those measured on the CT.**

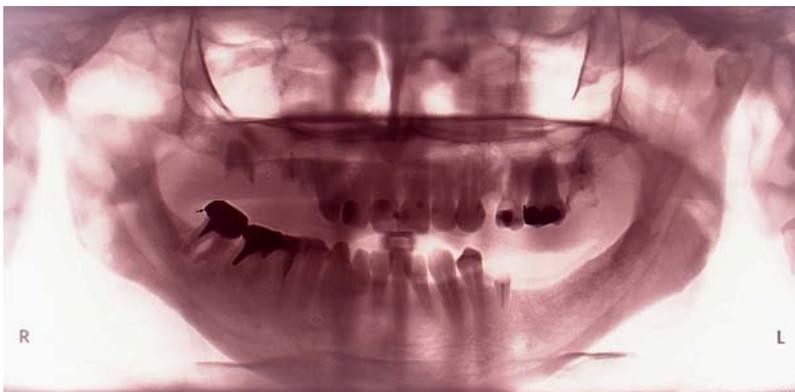
### Examples

T.R., a 48 years old patient has a terminal edentulous maxilla with **D2-D3** bone density and a terminal edentulous mandible with **d3** bone density.

I.A.S., a 35 years old patient, has a termino-terminal edentulous maxilla, a **D2-D3** bone density, complete tooth ridge resorbtion on the right side and a 5 mm tooth ridge on the left side of his maxilla; the mandible presents terminal edentulous areas and **d2-d3** bone density.



Patient :T.R: – square: D3  
– oval: D4  
– circle: D5.



Patient: I.A.S: – square: D3  
– oval: D4  
– circle: D5.

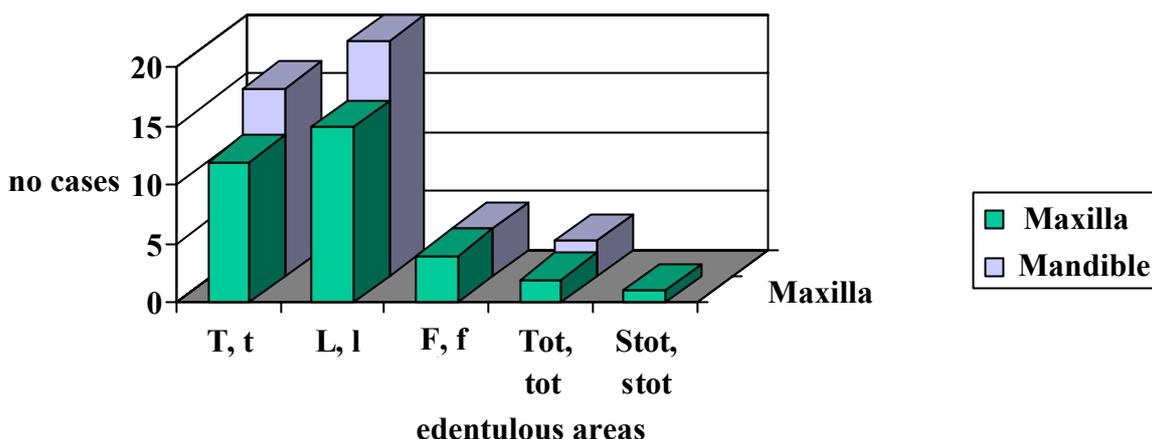


Below you can find the complete data table, considering the above observation:

No.	Name	Year	Sex	Edentulous areas	Density, observations
1	D.I.	1961	m	L-T;l-extended f	2T = 0 ; lext- f = d1- d2 aug
2	C.I.	1949	m	t-t	t = d2-d3
3	C.O.C	1982	f	L	L = d 3-d4
4	E.P.	1984	f	l	l=d3-d4
5	H.C.	1973	m	L; l- l	D3-D4, d2-d3
6	G.J.	1967	m	t	d2-d3
7	G.G.	1950	f	T-F-L; t	D3-D4,d2-d3
8	E,D	1970	m	l	d2-d3
9	L.P.M	1943	f	L	D2-D3
10	N.M.C.	1981	f	l	d2-d3
11	N.M..	1969	f	l	d3-d4
12	P.L.	1970	f	F	D2-D3
13	E.I.	1962	m	SUBTOT,tot	D2-D3,d2-d3
14	T.R.	1959	f	T, t	D2-D3,d3-d4
15	Z.C.	1950	m	L-T, t-t	D3-D4,d2-d3
16	V.S.G	1976	m	l-l	d2-d3
17	T.A.	1954	m	t-t	d2-d3
18	U.G.	1968	m	T,L,F-F-L,T; t-t	D3 ,d2
19	D.D.	1981	f	L	D3-D4
20	N.E.	1951	f	T-T;	D2-D3,LS
21	M.M.	1937	m	T,l,f,t	D3-D4,LS?;d2-d3
22	M.S.	1977	f	L;l-l	D3-D4; d2-d3
23	M.C.	1968	f	l	d3-d4
24	L.R.	1969	f	T-T	D2-D3,2T=0
25	C.D	1958	f	T-L; l-t	D2-D3; d3-d4
26	A. C.	1951	m	TOT, t,f,t	D2-D3;d2-d3
27	C.T.	1969	m	L-L;l-l	D2-D3;d3-d4
28	C,S	1956	m	T-T;f-t	D2-D3;d3-d4; 2T=0
29	D.D.	1967	m	t-t	d2-d3
30	P.S.	1951	m	L-T	D3-D4
31	P.C.	1964	m	TOT;t-t	D2-D3;d2-d3

32	P.I.	1968	f	T-T	D2-D3;1T=0 ;1T=5mm
33	R.C.T	1984	f	l-l	d2-d3
34	P.F.	1979	m	L;l-l	D2-D3;d2-d3
35	I.A.S.	1972	m	T- T; t	D2-D3, 1T=0 ;1T=5mm ;d2-d3
36	R.I.	1952	m	tot	d2-d3
37	R.I.M.	1977	f	l-l	d2-d3
38	S.M.	1948	f	L;l	D3-D4; d2-d3
39	R.I.	1944	f	tot	d2-d3
40	I.G.	1961	m	l	d2-d3
41	B.S.	1953	f	F	D2-D3
42	D.L.	1950	f	T,F,T;t-t	D2-D3;d2-d3
43	B.E.	1954	f	L-L;l-t	D3-D4;d2-d3
44	D.A.	1940	f	t	d3-d4
45	G.O.	1977	f	l	d2-d3
46	D.I.	1983	f	l	d2-d3

**Legend:** T = terminal edentulous maxilla; L = lateral edentulous maxilla; F = frontal edentulous maxilla; l = lateral edentulous mandible; t = terminal edentulous mandible; f = frontal edentulous mandible; Tot = complete edentulous maxilla; tot = complete edentulous mandible; 1T0 sau 2T0 = maximum tooth ridge resorption in the terminal maxillary area, close to the maxillary sinus, on one or both sides of the maxilla. D1-D3 = maxillary bone density; d1-d3 = mandibular bone density; LS = sinus lift needed; 1T = 5mm = terminal edentulous area having 5 mm between the tooth ridge and the maxillary sinus.



Values obtained by the concise integration of the data:

- male/female ratio: 21/25=0,84
- age varies between 23 and 67 years – types of edentulous areas: T-12 patients; L-15 patients; F-4 patients; t-16 patients; l-20 patients; f-4 patients; Tot-2 patients; SubTot-1 patients; tot-3 patients.
- bone densities: d1-1 patient; d2: 28 patients; d3=35 patients; d4=9 patients; D2= 16 patients; D3= 24 patients; D4=9 patients.

**CONCLUSION**

Comparing X-ray measured bone densities to those measured on CT, we are able to state the following:

a). the method is correct, meaning that the bone density revealed by the X-ray corresponds to the

real one-fact proven by the Computed Tomography measurements.

b). in the evaluated area there is always bone of lower quality than that measured on the X-ray.

c). in most of the measured areas, there can exist bone of extreme low density (D5), considering the fact that CT is a very accurate method and the spot measured can belong to a less dense bone trabecula. This aspect does not change the prior statements.

**To conclude, we can evaluate the bone density on a panoramic X-ray, but we have to look at the aspect in a rather “pessimist” manner, given the fact that poor quality bone is always present in the evaluated area.**

The mandibular d4 bone type and the maxillary D4 bone type are directly related in our group of selected patients; the main distinction between the mandible and the maxilla is the compact bone

thickness. Most frequently we find D3 (d3) bone type and then D2 (d2) bone type. D1 (d1) bone type is a seldom finding.

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