

Application of Tomographic Methods in the Diagnosis of Pathological Changes of the Jaw

Tihomir Kuna¹, Ivona Bago² and Irina Filipović-Zore¹

¹ University of Zagreb, School of Dental Medicine, Department of Oral Surgery, Zagreb, Croatia

² University of Zagreb, School of Dental Medicine, Department of Endodontics and Restorative Dentistry, Zagreb, Croatia

ABSTRACT

The aim of this study was to evaluate the frequency of specific diagnostic methods used for diagnosis of oral pathologies. The sample consisted of 198 patients (98 men and 100 women) with formulated diagnosis, confirmed postoperatively by histopathological verification. In 74.7% of subjects only X-ray diagnostic examination was used. Both X-ray and computed tomography (CT) examinations were used in 18.7% of subjects. Magnetic resonance imaging (MRI) wasn't performed in any subject. In 6.6% of subjects neither X-ray nor CT was performed. The study reported on statistically significant differences in the distribution of specific diagnostic methods according to age groups ($p=0.026$). Also, there was statistically significant differences in the distribution of diagnostic methods according to diagnostic groups ($p=0.053$). In the group of 37 subjects, in whom both X-ray and computed tomography were used, the majority had carcinomas, followed by fractures and inflammatory cysts.

Key words: computed tomography, diagnostic methods, oral surgery

Introduction

Radiology is useful and necessary in the diagnosis and treatment of oral diseases such as caries, periodontal diseases and oral pathologies. The Scientific Committee on the Atomic Effects of Radiation within the United Nations noted that dental radiography was the most frequent radiographic technique in medical practice. Dental radiography accounts for nearly one third of all the total number of radiological examinations conducted within the European Union¹.

The final X-ray image can be described as a two-dimensional picture made up of a variety of black, white and gray superimposed shadows. Teeth and jaw bones are hard tissues which show up particularly well on radiographs. Although simple, X-ray equipment can produce reasonable intra-oral dental radiographs with good image contrast and relatively high resolution. Anatomical restrictions in the dentomaxillofacial region limit the projection angle to certain pre-defined planes making multiple projections at different angles difficult.

Rapid advances in diagnostic imaging and computer technology have major impact in dental radiology and dental practices as a whole. The use of computed tomog-

raphy (CT) scans has increased dramatically over the last two decades in dentistry². In the United States, there were about 3 million CT scans performed in 1980, compared to an estimated 72 million scans in 2007³. CT provides data using a narrow fan-shaped X-ray beam transmitted through the patient. The patient is imaged slice-by-slice, usually in the axial plane, and interpretation of the images is achieved by stacking the slices to obtain multiple 2D representations. CT scan has been proven to be an effective, efficient and economical diagnostic procedure which provides detailed views of soft tissues, bones and blood vessels⁴. It completely eliminates the superimposition of images of structures outside the area of interest and is characterized by high contrast resolution. Finally, CT provides less ionizing radiation⁴. There are many studies proving excellent use of CT in oral rehabilitation planning including implantology⁵. Compared with CT pictures, magnetic resonance imaging (MRI) is more correct and offers more diagnostic information⁴. Publications on the use of MRI in dentistry have included studies concerning the temporomandibular joint⁶, nasopharyngeal tumors⁷, inflammatory conditions of the facial

skeleton and assessment of mandibular and maxillary bone prior to dental implant placement^{8,9}. MRI uses non-ionizing radio frequency signals to acquire its images and is best suited for non-calcified tissue. However, for most dental practitioners, the use of advanced imaging has been limited because of the cost, availability and radiation dose considerations.

The aim of this study was to evaluate the frequency of specific diagnostic methods used for making clinical decision in oral surgery, and to offer the possible solutions for improving routine dental practice.

Materials and Methods

The study was performed in the Department of Maxillofacial Surgery and the Department of Oral Surgery, Dubrava University Hospital in Zagreb. The study group comprised randomly selected patients who had been treated at the departments where the investigation was performed. Data for the study were collected from the Hospital archives which related to the period from the 1st January 1999 to the 30th June 2003 (a total of 54 months).

Medical documentation of each participant of the study included radiographs and/or CT, and confirmed diagnosis postoperatively by histopathological verification. Special group comprised patients with complications during treating, difficulties in diagnosis and in preoperative anatomical orientation and evaluation. These patients were besides X-ray examination, directed to MRI. Results obtained by X-ray examination were compared with CT or MRI.

Statistical analysis

Collected data were electronically organised and transferred into a database designed for this study.

Univariate methods were used for statistical analysis. Most of the statistical methods used in the study were based on analysis of qualitative characteristics of nominal data and distribution of frequency of these data. Descriptive statistical methods included frequency distribution tables and gauge decline around arithmetic mean: arithmetic mean and standard deviation. For analysis of the collected data chi-square test was used. Statistical analysis of data was performed using software package SPSS 10.0.

Results

The study group consisted of 198 subjects, 100 women and 98 men. X-ray examination was performed in 74.7% of the patients. CT imaging was performed in 18.7% of the patients, and in 6.6% neither X-ray nor CT. MRI wasn't performed in any subject.

17 different diagnosis, found in the study group, were divided in 4 diagnostic groups. Table 1 showed distribution of subjects according to the diagnostic groups.

The study reported on statistically significant differences in distribution of specific diagnostic methods ac-

TABLE 1
DISTRIBUTION OF SUBJECTS ACCORDING TO DIAGNOSTIC GROUPS

Diagnostic group	Frequency	Percentage
Odontogenic tumors	33	16.7
Cysts	44	22.2
Gigantocellular changes	19	9.6
Other	102	51.5
Total	198	100

TABLE 2
DISTRIBUTION OF DIAGNOSTIC METHODS ACCORDING TO AGE GROUPS

Age groups	Diagnostic method			Total
	X-ray	X-ray+CT	No	
2–15 years	28	0	3	31
16–30 years	39	12	4	55
31–50 years	36	14	4	54
51–83 years	45	11	2	58
Total	148	37	13	198

CT – computed tomography

ording to age groups (Likelihood Ratio χ^2 -test: $\chi^2=16.351$; $p=0.012$; Fisher's exact test: $p=0.026$, Table 2). Also, there was statistically significant differences in distribution of the diagnostic methods according to the diagnostic groups (Likelihood Ratio χ^2 -test: $\chi^2=14.208$; $p=0.027$; Fisher's exact test: $p=0.053$, Table 3).

In the group of 148 subjects, in whom only X-ray examination was performed, the majority of patients had inflammatory cysts (24 subjects) and inflammation spreading in the region of neck (23 subjects). There were 13 diagnosis of follicular cysts and 13 fractures. In the group of 37 subjects, in whom both CT and X-ray examination were used, the majority of diagnosis were carcinoma (12 subjects). 8 subjects had fractures and 4 inflammatory cysts. In the group without any radiographic examina-

TABLE 3
DISTRIBUTION OF DIAGNOSTIC METHODS ACCORDING TO DIAGNOSTIC GROUPS

Diagnostic group	Diagnostic methode			Total
	X-ray	X-ray+CT	No	
Odontogenic tumors	26	4	3	33
Cysts	39	5	0	44
Gigantocellular changes	15	2	2	19
Other	68	26	8	102
Total	148	37	13	198

CT – computed tomography

tion used (13 subjects), 5 of them had inflammation spreading in the region of neck, 3 had odontogenic fibroma, 3 had hemangioma and 2 peripheral giant cell fibroma.

Discussion and Conclusion

The most frequent diagnostic method in this study was X-ray examination (74.7%). The wide use of panoramic radiography has also been observed in other countries. In general dental services in England and Wales approximately 2,05 million panoramic radiographs were taken between 1998 and 1999¹⁰. Recent study performed in Spain reported on 131 dental X-ray exposures *per* 1,000 inhabitants¹¹. X-ray examination is fast and easy, and is particularly useful in emergency diagnosis and treatment. Also, X-ray equipment is relatively inexpensive and widely available so examinations are usually convenient for both patients and physicians. Results of the study showed that X-ray examination was used for all diagnosis, mostly for the diagnosis of inflammatory cysts and other odontogenic and non-odontogenic cysts, fractures and inflammation spreading in the region of neck. These observations suggest rational choice of diagnostic method in preoperative arrangements. However, there are cases where clinical diagnosis shown in the radiographs wasn't accurate and histopathological findings showed rare odontogenic lesion¹².

According to the results of this study CT was used only in cases where X-ray examination wasn't sufficient enough for accurate assessment of pathological lesions. It was most often used for the diagnosis of carcinoma, inflammatory cysts and fractures. Such selection of CT is in unison with the recommendations of other studies. Gomez et al.¹³ proposed that CT is complementary diagnostic procedure for distinguishing cystic lesions. CT is very important in diagnosis of tumors with undefined borders, atypical cystic lesions which spread in the surrounding area¹⁴. It is also frequently used in assisting surgical biopsies for confirmation of certain diseases¹⁵. However, our results showed rare use of CT in oral and

maxillofacial surgery (18.7%), which can be explained in several ways. Despite many benefits, several disadvantages are present with CT imaging, and dentists should provide rationales for image selection for diagnosis, treatment planning and follow-up of patients¹⁶. One of disadvantages is cost and availability. Also, there is a risk of allergic reaction (renal, cardiac and hypersensitivity) to the contrast agent¹⁷. Due to the physical shape of the CT equipment, claustrophobic patients may experience anxiety. In the most recent comprehensive survey in the United Kingdom, CT scans constituted 7% of all radiologic examinations, but contributed 47% of the total collective dose from medical X-ray examinations in 2000/2001¹⁸. However, the benefits achieved from a CT scan outweigh the risks from small radiation dose received during CT imaging¹⁹.

Thirteen surgical interventions (6.6%) were performed without preoperative radiographic examination. Rational and adequate clinical decision in these situations can be explained by smaller number of such interventions, clear clinical findings, and possibility that these cases required emergent intervention. Also, there is possibility that emergent interventions improved clinical finding of the patient, so further radiographic examinations weren't necessary.

The main conclusion of this study was to emphasise that all patients must have clinical history and clinical examination taken prior to any radiological examination. The fact that there weren't any case where MRI was used as a diagnostic method, leads us to the conclusion that MRI hasn't become routine diagnostic method in oral and maxillofacial surgery, and that selection of other diagnostic methods was efficient enough in accurate diagnostic assessment. Also, it is important to evaluate the advantages of particular diagnostic methods according to the specific diagnostic needs. Finally, it is necessary to proceed with further investigation in the field of medical diagnosis in order to provide simple, cost effective and highly accurate diagnostic technique in routine dental practice.

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I. Bago

*University of Zagreb, School of Dental Medicine, Department of Endodontics and Restorative Dentistry, Gundulićeva 5,
10000 Zagreb
e-mail: ivonabago@yahoo.com*

PRIMJENA TOMOGRAFSKIH METODA U DIJAGNOZI PATOLOŠKIH PROMJENA ČELJUSTI

S A Ž E T A K

Svrha ovog rada bila je ispitati učestalost primjene specifičnih dijagnostičkih metoda u dijagnostici patoloških promjena čeljusti. U studiji je sudjelovalo 198 pacijenata (98 muškaraca i 100 žena) s dijagnozom koja je potvrđena patohistološkim nalazom postoperativno. Klasična rendgenska pretraga je učinjena kod 74,7% ispitanika. Rendgenska pretraga i kompjuterizirana tomografija su obavljene kod 18,7% ispitanika. Kod niti jednog ispitanika nije učinjena pretraga magnetskom rezonancijom. Kod 6,6% ispitanika nije učinjena ni rendgenska pretraga ni kompjuterizirana tomografija. Rezultati studije ukazuju na statistički značajnu razliku u distribuciji specifičnih dijagnostičkih metoda prema starosnim grupama ($p=0,026$). Također, statistički je značajna razlika u distribuciji dijagnostičkih metoda prema dijagnostičkim grupama ($p=0,053$). U grupi od 37 ispitanika kod kojih je učinjena i rendgenska pretraga i kompjuterizirana tomografija, većina ispitanika je imala karcinom, prijelome i upalne ciste.