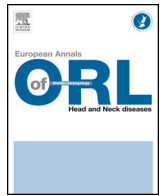




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Original article

# Accuracy of limited four-slice CT-scan in diagnosis of chronic rhinosinusitis



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## ABSTRACT

**Objective:** Chronic rhinosinusitis (CRS) is a common chronic health condition worldwide. Standard CT-scan is the method of choice for diagnosis of CRS but its high price and considerable radiation exposure have limited its application. The main goal of this study was to evaluate the accuracy of limited four-slice coronal CT-scan in the diagnosis of CRS.

**Material and method:** This cross-sectional study was conducted on 46 patients with CRS, for one year, based on American Society of Head and Neck Surgery criteria. All patients received the preoperative standard and four-slice CT-scans, after which endoscopic sinus surgery was performed. Findings of four-slice CT-scans were compared with those of conventional CT-scan and the sensitivity and specificity of four-slice CT-scan and its agreement with conventional CT-scan was calculated.

**Result:** In this study, 46 patients including 32 males (69.6%) and 14 females (30.46%) with a mean age of 33 and standard deviation of 9 years, were evaluated. Sensitivity and specificity of four-slice CT-scan were 97.5% and 100%, respectively. Also, positive predictive value (PPV) and negative predictive value (NPV) of four-slice CT was 100% and 85.71%, respectively. There was a strong agreement between four-slice CT and conventional CT findings.

**Conclusion:** Considering the high sensitivity and specificity of four-slice CT-scan and strong agreement with conventional CT-scan in the diagnosis of CRS and the lower radiation exposure and cost, application of this method is suggested for both diagnosis and treatment follow-up in CRS.

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## 1. Introduction

Chronic rhinosinusitis (CRS) is an inflammatory disorder that involves the paranasal sinuses and is characterized by nasal congestion, facial pain, anterior or posterior nasal discharge, and reduced or absent sense of smell, lasting more than 12 weeks [1].

CRS is the second most common chronic health condition worldwide and its prevalence has been reported at 12% in the US population [2,3]. It is the fifth most common disease treated with antibiotics [4].

The diagnosis of CRS is based on clinical manifestations and confirmation by imaging studies such as radiography, computed tomography (CT) scan and magnetic resonance imaging (MRI) [4]. Conventional radiography is the most commonly used diagnostic

tool for this purpose [5] but its sensitivity and specificity are relatively low in comparison to conventional CT-scan [5] although an agreement of 75.3% has been reported between conventional radiography and CT-scan findings [6].

Conventional CT-scan has high sensitivity and specificity in the diagnosis of CRS [5,7] but its application is limited by its high price and considerable radiation exposure compared to plain radiographs [5,7].

MRI is not a proper modality for assessment of bony structures of the paranasal sinuses and skull base; instead, these structures are best evaluated by standard CT-scan [8–10]. MRI provides detailed information about the soft-tissue structures of paranasal sinuses and skull base and it is superior to CT-scan in differentiation of inflammatory and neoplastic lesions [8–11].

Conventional CT-scan is the method of choice and gold standard for diagnosis of CRS [5]. With this method, the anatomy of the paranasal sinuses and its normal variations increased thickness of the membrane lining and increased bone density of the sinus wall

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**Table 1**  
Accuracy of four-slice CT-scan as compared with standard CT-scan in diagnosis of CRS.

Sinus	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Agreement of four-slice CT with standard CT-scan (%)
Right frontal	76.19	92	88.89	82.14	76
Left frontal	85	96.15	94.44	89.29	87
Right ethmoid	88.89	94.74	96	85.71	74
Left ethmoid	85.71	94.44	96	80.95	74
Right maxillary	90.63	92.86	96.67	81.25	83
Left maxillary	93.94	100	100	86.67	83
Right sphenoid	76.47	89.66	81.25	86.67	78
Left sphenoid	90.48	88	86.36	91.67	78

PPV: positive predictive value; NPV: negative predictive value.

are well shown [8–10]. Standard CT-scan, by providing continuous slices, exposes the patient to higher radiation doses and imposes more cost to the patient and medical system [5,7]. Reducing the radiation dose is as important as high image quality [12]. Reducing the number of slices may be considered a solution for the limitations of standard CT-scan, because it could decrease radiation exposure and imaging cost [13–15].

Four-slice coronal CT-scan of paranasal sinuses, with its limited number of slices (mid-frontal, anterior maxillary, posterior maxillary and mid-sphenoidal views) has lower cost and radiation dose [16]. This study aim was to evaluate the accuracy (sensitivity and specificity) of four-slice coronal CT-scan in the diagnosis of chronic rhinosinusitis.

## 2. Material and method

This cross-sectional study was conducted on 46 patients with CRS based on American Society of Head and Neck Surgery criteria [17], that required functional endoscopic sinus surgery (FESS). Patients with previous history of sinus surgery were excluded.

The study protocol was approved by the ethics committee at our university. All patients gave informed consent before enrolment.

Forty-six patients 32 (69.6%) males and 14 (30.4%) females; with a mean age, 33 years (standard deviation of 9 years) were included in the current retrospective analysis.

Before FESS, for each patient, standard CT-scan with thickness of 5 mm and interval of 10 mm and four-slice CT-scan with thickness of 3 mm and interval of 10 mm were taken.

All CT-scans were obtained using the Philips MX8000 CT-Scanner (Philips Co., USA). CT-scans were reviewed and interpreted by two radiologists and were scored with the Lund-Mackay staging system for chronic rhinosinusitis as: 0 (complete lucency), 1 (partial lucency) or 2 (complete opacity) [18]. The radiologist who viewed the four-slice CT-scans was blind to the findings of standard CT-scan as well as the patients' clinical presentations.

For each sinus, findings of four-slice CT-scans were compared with the findings of conventional CT-scan and the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of four-slice CT-scan were calculated.

Data were analyzed by SPSS software version 17.00 for Windows. Data were presented as mean ± SD for numerical data and as number and percentage for categorical data. The independent-sample *t*-test was used for comparison of quantitative data with normal distribution, and the Chi<sup>2</sup> test for comparison of categorical data. *P*-values less than 0.05 were considered significant.

## 3. Result

The sensitivity, specificity, PPV and NPV of four-slice CT-scan are shown in Table 1, as well as agreement between four-slice CT-scan and standard CT-scan. Total PPV and NPV for four-slice CT-scan

were 100% and 85.71%, respectively. Also, sensitivity and specificity of four-slice CT-scan were 97.5% and 100%, respectively.

The highest false-positive rate in four-slice CT-scan was in the right and left sphenoidal sinuses and the lowest in the right maxillary sinus. The highest false negative rate was in the right frontal sinus.

Also, the difference between four-slice and standard CT-scans was 24% in right frontal, 13% in left frontal, 26.1% in right ethmoidal, 26% in left ethmoidal, 17.3% in right maxillary, 27.4% in left maxillary, 30.4% in right sphenoidal and 21.7% in left sphenoidal sinuses. There was a moderate to strong agreement between four-slice CT and conventional CT-scans findings (74%–87%).

## 4. Discussion

Since CRS is an inflammatory disease with multiple causes, diagnosis and treatment are difficult [16]. In the past, plain radiography was the method of choice for evaluating paranasal sinuses; however, it is not suitable for assessment of anatomical structures such as anterior ethmoidal cells, the osteomeatal complex and middle turbinates [16]. The relatively low diagnostic sensitivity and specificity of radiography has led to substitution of CT-scan, which provides detailed information of sinuses [5,19,20].

In Awida et al.'s study conducted on 51 patients, four standard CT-scan slices, including mid-frontal, anterior maxillary, posterior maxillary and mid-sphenoidal, were selected and complete CT-scan was considered as gold standard. The findings of these four slices were compared with those of complete CT-scan [13]. The study found sensitivity of 81.3%, specificity of 89.5%, NPV of 73.9% and PPV of 92.9% for four-slice CT-scan [13], which were higher than that for plain radiography. The sensitivity, specificity, NPV and PPV of four-slice CT-scan in our study were higher than their reported values [13].

Cagici et al. evaluated the accuracy of three standard CT-scan slices, including frontal, anterior maxillary and ethmoidal and sphenoidal slices, as an alternative to standard CT-scan in diagnosis of CRS and its treatment follow-up [19]. They evaluated 136 patients and found 95.1% sensitivity and 92.6% specificity for three-slice CT-scan [19], which is close to our findings and is confirmed by our study. The frontal sinus slice, with 100% sensitivity, showed the highest sensitivity and the maxillary sinus slice, with 94.12% sensitivity, had the lowest. The highest specificity belonged to the frontal sinus slice, with 94.34%, and the lowest to the ethmoidal sinus slice, with 82.54% [19]. Compared with our study, however, there were more patients in that study, but the reported sensitivity and specificity were lower than ours [19]. The lowest specificity was found in the sphenoidal sinus, which is similar to our data [19].

The study by Nourian et al. determined the diagnostic accuracy of ten-slice CT-scan compared with standard CT-scan in the diagnosis of sinusitis in 150 patients [20]. They reported sensitivity, specificity, PPV and NPV of limited CT-scan in diagnosis of sinusitis at 94%, 92%, 90% and 95%, respectively [20]. The number of slices

was greater than in our study, but the sensitivity and specificity of our findings are similar or even higher than theirs [20].

In Sharifian et al.'s study of 120 patients, with the purpose of determining the accuracy of limited CT-scan in diagnosing sinusitis, a sensitivity of 95%, specificity of 92%, PPV of 96% and NPV of 90% were reported, which are as the same as our findings [21] although the device used and the number of slices were different from ours.

Tantilipikorn et al.'s study of 132 patients concluded that limited CT-scan can be used in patients with involvement of the anterior sinuses, but its accuracy is not appropriate for assessment of the posterior sinuses and the standard full CT should be considered [16].

## 5. Conclusion

Our study findings show high accuracy of four-slice CT-scan in diagnosis of CRS and revealed strong agreement between four-slice and standard CT-scan findings. Considering the high sensitivity and specificity, and low radiation exposure and cost of four-slice CT-scan, its application is suggested in diagnosis of CRS.

## Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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