

COMPARISON OF X-RAY AND CT SCAN IN EVALUATION OF SINUSITIS

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Abstract

Background: Sinusitis is a prevalent condition with varying degrees of severity and complexity. It can be caused by viral, bacterial, or fungal infections, and can be acute or chronic in nature. The diagnosis of sinusitis is often based on clinical presentation, laboratory tests, and imaging studies. However, the diagnostic accuracy of imaging modalities such as X-rays and CT scans has not been well established. This study aims to evaluate the diagnostic performance of X-rays and CT scans in detecting sinusitis.

Objective: To evaluate the diagnostic accuracy of X-rays and CT scans in sinusitis cases.

Methods: A prospective, Cross sectional study of 164 suspected sinusitis cases was conducted. X-rays and CT scans were evaluated for diagnostic accuracy.

Results: CT scans showed higher sensitivity (97.3%) and specificity (96.2%) compared to X-rays (75.0% and 85.0%, respectively). Consequently, X-rays had a true positive rate of 75.0%, a true negative rate of 85.0%, a false positive rate of 25.0%, and a false negative rate of 15.0%. In contrast, CT-scans had a true positive rate of 97.3%, a true negative rate of 96.2%, a false positive rate of 2.7%, and a false negative rate of 3.8%. Mucosal thickening and sinus opacification were common radiographic signs.

Conclusion: CT scans are more accurate than X-rays in diagnosing sinusitis. This study highlights the importance of CT scans in sinusitis diagnosis, particularly in cases with complex anatomy or severe symptoms.

Keywords:

X-rays, Computed tomography scan, Acute sinusitis, Chronic sinusitis, Paranasal sinuses.

Introduction

The paranasal sinuses are vacant, air-containing chambers present in the facial bones and cranial base, around the nasal passage. Paranasal sinuses play an essential role in minimizing the cranial weight, moisturizing and warming of inhaled air, pressure control within the nasal cavity, also filtering dust particles(1). The paranasal sinuses consist of four pairs, each attached to the nasal cavity by narrow duct. They include the maxillary, sphenoid, frontal and ethmoidal sinuses(2).

Sinusitis is generally defined as the inflammation of the mucosal membrane of nasal and paranasal sinuses. Symptoms of sinusitis include cough, sore throat, headache, nasal blockage, nasal discharge and nasal allergies(3).Previous research has shown that a variety of factors, including allergies, tobacco use, trauma, alcohol use, prolonged cold exposure and infections by fungus, bacteria or viruses, can make persons more susceptible to various disorders of the para nasal sinuses(1).There are four types of sinusitis: acute, subacute, chronic, and recurrent.

It is currently clear that sinusitis is primarily diagnosed clinically. When the history clinically indicates sinusitis, a focused physical examination may be able to differentiate it from a simple upper respiratory tract infection(4).The primary indications for sinus imaging include supporting clinical evidence, clarifying ambiguous diagnoses, and investigating treatment resistance. X-ray has become the state of the art as technology has developed. It is simple to use, requires just a moderate level of skill, and exposes the patient to significantly less radiation. Also, it is very cost effective (5)(6).

In the early treatment of both acute and chronic sinusitis, sinus radiography is still a crucial and less expensive diagnostic technique(7). The projection that clinicians most frequently request to diagnose sinusitis is the occipitomeatal or Water's view.(Figure 1) The maxillary sinuses can be seen clearly in this view. The frontal sinus is projected obliquely. The ethmoid air cells are located inside the nose and along the orbit's medial walls. The sphenoid sinus can be seen via the open mouth.



Figure 1: First image is abnormal shows sinusitis; second image shows normal PNS X-Ray and the third image also shows sinusitis.

Air-fluid levels, opacification, mucosal thickening, and haziness are all signs of sinusitis on plain radiography. The majority of sinusitis patients would be diagnosed using simply the Waters view because the majority of research have shown that around 90% of cases involve the maxillary sinuses (8)(5).

Currently, computed tomography (CT) scans are utilized for sinusitis diagnosis. Although CT scans are more accurate, plain films have compensating benefits in terms of accessibility, examination ease, radiation safety, and cost (9).The advancement of CT equipment has resulted in modern CT scanners, which maintain the diagnostic quality of images at a lower radiation dose and examination time than older scanners(10).(Figure 2)

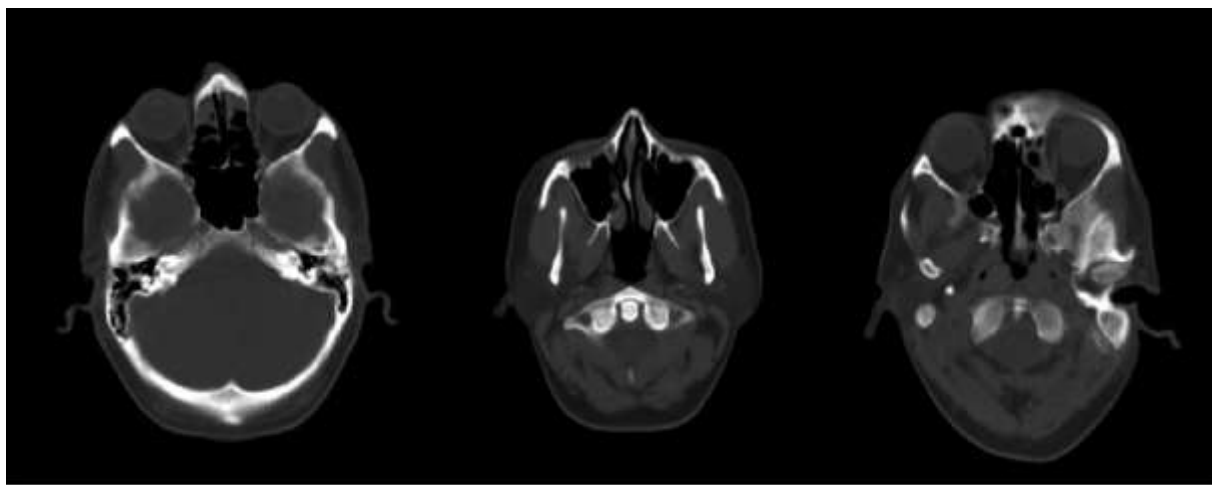


Figure 2: first image Shows normal PNS CT Scan, second image shows nasal turbinate's hypertrophy and the third image shows opacification and calcification.

Despite the lack of previous studies evaluating the reliability of X-rays and CT scans in assessing paranasal sinuses pathologies, the existing literature is further limited by single-center designs, which restrict generalizability. Therefore, this investigative study aims to address these gaps by conducting a multi-center investigation, thereby enhancing the reliability and generalizability of the findings and will be the first of its kind to be conducted in Swabi and will contribute to the advancement of medical knowledge in this region.

Material and Methods:

This study was designed as a prospective cross-sectional study and conducted for the comparison of diagnostic accuracy of x-ray and CT scan in patients suspected with sinusitis in District Swabi, KPK. This study was carried out at multiple centers; Mahaban medical and Research Hospital Topi, Swabi, Allied Medical Complex Swabi and Al-Hadi international hospital over a period of four months. Ethical approval for the research was obtained from the institutional review board to ensure adherence to ethical guidelines. The study included a total of 164 participants, comprising 82 X-rays patients and 82 CT-Scan patients. First, we verified the eligibility of patients based on the inclusion and exclusion criteria. This study included all those patients with sinusitis referred from ENT (OPD) to radiology department for X-rays and CT- scan. Patients with facial trauma and with previous nasal surgery or infections other than sinusitis were excluded from our study. After that we extracted demographic details from them. For imaging x-ray machine (GE health care) and multi detector CT scan (Toshiba) were used. After that we analyzed x-ray and CT scan images of paranasal sinuses and accessed sinus anatomy and abnormalities including mucosal thickening, Air fluid level and bony changes.

Digital radiography system (GE health care) was used for these imaging. For sinusitis both Water's view and Caldwell view are taken. In Water's view the patients were seated in front of upright detector. The patient's forehead was placed against the image detector and insured that their nose and forehead both touched the detector. The tube was positioned (PA) and angled 15° at the nasion. In Caldwell view the patients were sit or stand facing the x-ray machine. The patient's head was positioned in erect position with chin slightly elevated. The patient's nose and forehead were placed against the image receptor. The beam was centered on the patient's nose and angled 15-20° caudally. Imaging acquisition parameters that were used in these positioning is 80-70 KV, 15-20 MAs. After that these images were analyzed for sinus opacity, Air fluid level and bony changes.

Multi detector CT scanner (Toshiba) was used. Non-contrast CT scan were used for paranasal sinuses. Patients were positioned supine and the direction of Scan was caudocranial. The scan extended from hard

palate to above the end of frontal bone. Imaging acquisition parameter’s that were used in that imaging was 125 KV, 80-160 MAs, 140-160 mm FOV with slice thickness 0.625-1.0 mm. After that these images were constructed into coronal and sagittal images. These images were then analyzed for sinus opacification, mucosal thickening and bony changes.

RESULTS:

In our study a total of 164 participants were included, which were divided into three categories on the basis of age. Category 1 included participants between 1-20 years (n=46), category 2 included participants between 21-40 years (n=93) and category 3 included participants above 41 years (n=25). (Table 1) (Figure 3)

Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-20	46	28.0	28.0	28.0
	21-40	93	56.7	56.7	84.8
	41 Above	25	15.2	15.2	100.0
	Total	164	100.0	100.0	

Table 1: Age of participants

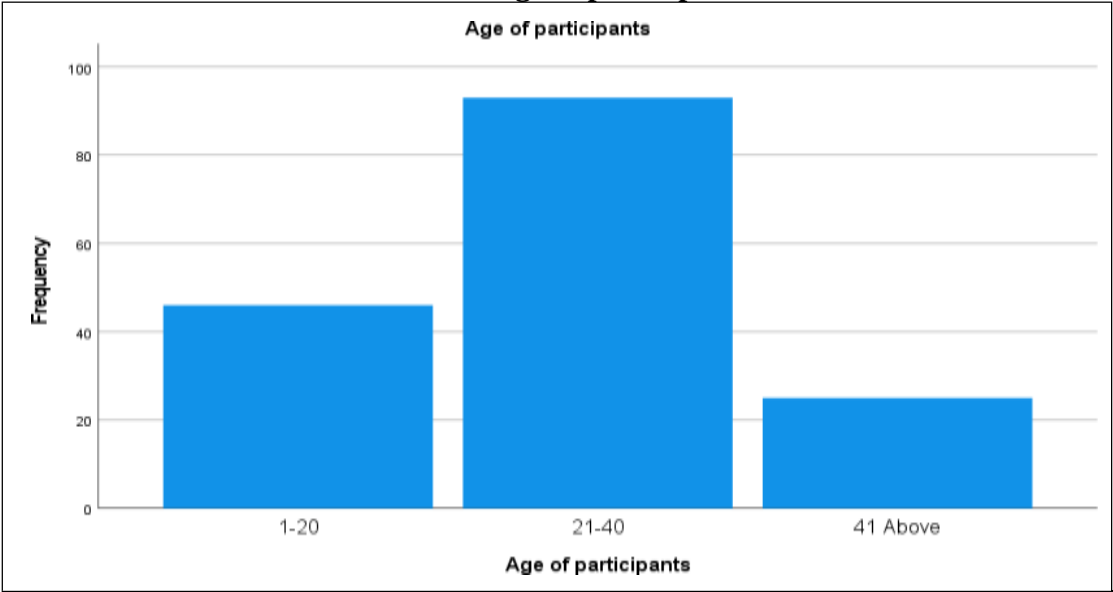


Figure 3: Age of Participants

The distribution of male and female participants among the 164 cases in the study was as follows: 98(59.8%) were males and 66 (40.2%) were females. In the male participant group, 59.8% represented the valid percentage, which was also the cumulative percentage. In contrast, in the female participant group, 40.2% represented the valid percentage, with a cumulative percentage of 100.0%. (Table 2) (Figure 4)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	98	59.8	59.8	59.8
	Female	66	40.2	40.2	100.0
	Total	164	100.0	100.0	

Table: 2: Gender of participants

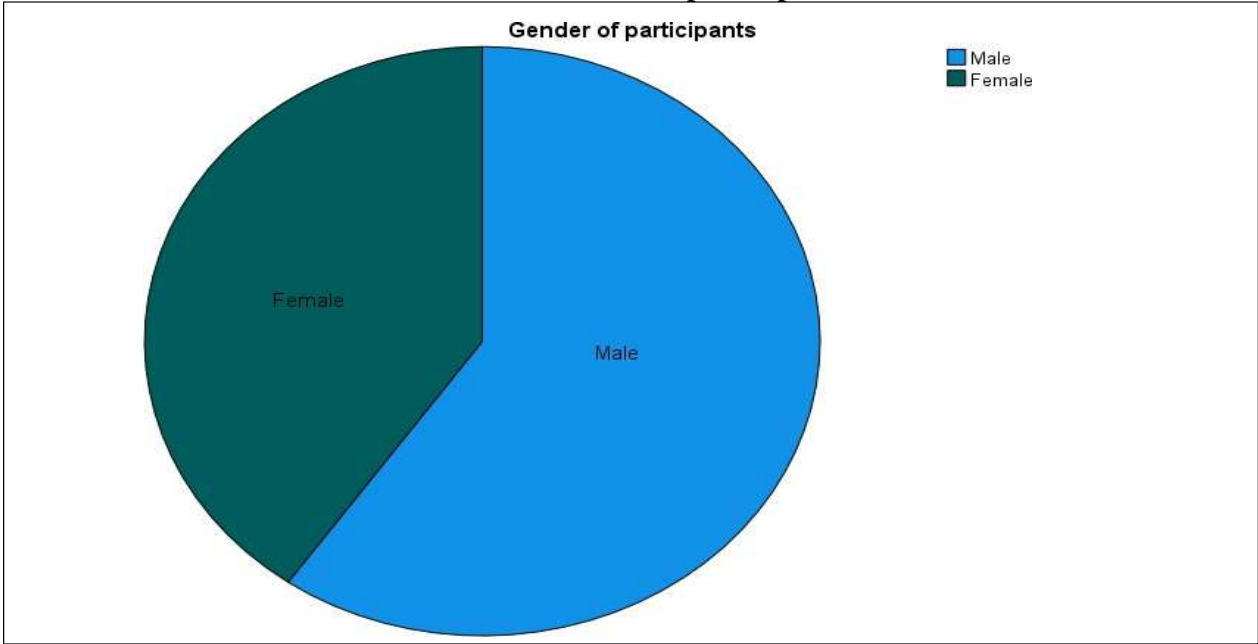


Figure 4: Gender of participants

The distribution of sinusitis cases among 164 patients was as follows: 55 (33.5%) had acute sinusitis, while 69 (42.1%) had chronic sinusitis. Out of the 55 (33.5%) cases of acute sinusitis, 33.5% represented the valid percentage, whereas the cumulative percentage was also 33.5%. Similarly, in the 69 (42.1%) cases of chronic sinusitis, 42.1% represented the valid percentage, and the cumulative percentage was 75.6%.40(24.4%) had no sinusitis,24.4% represented the valid percentage, and the cumulative percentage was 100.0% (Table 3)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Acute sinusitis	55	33.5	33.5	33.5
	Chronic sinusitis	69	42.1	42.1	75.6
	No sinusitis	40	24.4	24.4	100.0
	Total	164	100.0	100.0	

Table: 3: On the basis of type of sinusitis present

Table 4 illustrated the distribution of modalities used in the study. Two imaging modalities were employed: X-rays and Computed Tomography (CT). Out of the total 164 cases, 82(50.0%) utilized X-rays, accounting for 50.0% of the valid percent and 50.0% of the cumulative percent. In contrast, 82 (50.0%) of the cases employed CT, representing 50.0% of the valid percent and 100.0% of the cumulative percent.

X-rays or CT-Scan					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	X-rays	82	50.0	50.0	50.0
	CT-Scans	82	50.0	50.0	100.0
	Total	164	100.0	100.0	

Table:4: Percentages of X-rays versus CT-Scans

In our study a total of 164 participants were included, in which X-rays had a true positive rate of 75.0%, a true negative rate of 85.0%, a false positive rate of 25.0%, and a false negative rate of 15.0%. In contrast, CT-scans had a true positive rate of 97.3%, a true negative rate of 96.2%, a false positive rate of 2.7%, and a false negative rate of 3.8%. Consequently, the sensitivity and specificity of X-rays were 75.0% and 85.0%, respectively, whereas CT-scans had sensitivity and specificity rates of 97.3% and 96.2%, respectively (Table: 5), (Table:6), (Table:7).

CT-Scan results	Positive	Negative
Positive	97.3%	3.8%
Negative	2.7%	96.2%

Table: 5 True Positive Rate, True Negative Rate, False Positive Rate, False Negative Rate of CT-Scan

X-rays results	Positive	Negative
Positive	75.0%	15.0%
Negative	25.0%	85.0%

Table: 6 True Positive Rate, True Negative Rate, False Positive Rate, False Negative Rate of X-rays

	Sensitivity	Specificity
X-rays	75.0%	85.0%
CT-Scan	97.3%	96.2%

Table: 7 Sensitivity and Specificity of X-rays and CT-Scan

Discussion

The study included 164 cases of suspected sinusitis, comprising 98 males (59.8%) and 66 females (40.2%), with a mean age range of 1-60+ years. Another study done by Nasreen et al. who published a study on diagnostic accuracy of CT scans, in which 51.1% of the patients in that study were males and 48.9% were females(11). The primary objective was to assess the sensitivity and specificity of X-rays and CT scans in diagnosing sinusitis. To ensure accurate data analysis, we collaborated with physicians and radiologists to interpret paranasal sinus (PNS) X-rays and CT scans.

The study's findings revealed that among the 164 cases examined, 55 (33.5%) had acute sinusitis, 69 (42.1%) had chronic sinusitis, and 40 (24.4%) had no sinusitis. Sinus opacification was found in 48.3% of acute sinusitis cases and 51.7% of chronic sinusitis cases on both X-rays and CT scans. Other radiographic signs included mucosal thickening in 20.0% of acute sinusitis cases and 80.0% of chronic sinusitis cases, as well as air-fluid levels in 53.3% of acute sinusitis cases and 46.7% of chronic sinusitis cases. These results are consistent with Varonen et al.'s international research (7). Mucosal thickness is a nonspecific signal, even though it is seen in more than 90% of sinusitis patients (6). Only around 60% of sinusitis cases have more specific symptoms, like full opacification and air-fluid levels(6).

In the current study, mucosal thickening was most commonly observed in the maxillary sinuses, followed by the ethmoidal sinuses, and then equally affecting the frontal and sphenoid sinuses. Furthermore, our results indicate that the maxillary sinuses are the most frequently affected site in sinusitis cases. Another study done by Madu for observed the same outcomes, determining that the maxillary sinus had a 66.7% percentage, followed by the ethmoidal, frontal and the sphenoidal sinuses, which have respective percentages of 34.2%, 12.5%, and 1.7%(11).

Our study found that X-rays had a true positive rate of 75.0%, a true negative rate of 85.0%, a false positive rate of 25.0%, and a false negative rate of 15.0%. In contrast, CT-scans had a true positive rate of 97.3%, a true negative rate of 96.2%, a false positive rate of 2.7%, and a false negative rate of 3.8%. Consequently, the sensitivity and specificity of X-rays were 75.0% and 85.0%, respectively, whereas CT-scans had sensitivity and specificity rates of 97.3% and 96.2%, respectively. A similar study by Kanwar et al reported that CT-scan resulted high accuracy than the X-ray examination for diagnosing acute sinusitis, they reported sensitivity 97.7% and specificity 97.8% for diagnosing sinusitis(10). Many research investigations have shown that CT scans are the gold standard for diagnosing paranasal sinuses because of their high accuracy rate(12)(13).

CONCLUSION

This study aimed to evaluate the diagnostic accuracy of X-rays and CT scans in sinusitis cases. The results showed that CT scans have higher sensitivity and specificity rates (97.3% and 96.2%, respectively) compared to X-rays (75.0% and 85.0%, respectively). The study also found that mucosal thickening and sinus opacification were common radiographic signs in sinusitis cases. The maxillary sinuses were the most frequently affected site. The findings of this study are consistent with previous research and highlight the importance of CT scans in diagnosing sinusitis. Our results show that CT scans have higher sensitivity and specificity than X-rays. The findings of this study have important implications for the diagnosis and management of sinusitis. While this study provides valuable insights, its results should be interpreted with

caution due to limitations such as geographical constraints. To enhance the generalizability of these findings, future research should aim to include more diverse and representative populations.

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