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Axial helical CT with reconstruction in the coronal plane versus coronal helical CT of paranasal sinuses

CT is a well established technique in diagnosing sinusistis and tumors in the paranasal sinuses. Coronal planes are preferred in paranasal CT because the region of the infundibulum is representing in the best manner for endonasal surgical intervention. The infundibulum serves as the predominant canal linking the maxillary sinus with the nasal cavity. The coronal section is the plane closest to the views of the endoscopist. However, not all patients can assume or maintain the required position for the coronal study. Moreover, there are artifacts attributable to patient body motion and dental amalgam. Helical CT permits rapid volumetric data acquisition and multiplanar reconstruction. Therefore, images only need to be obtained in one plane. Data acquisition time as well as radiation dose is reduced in helical CT (1).

The aim of the study was assessment of the diagnostic value of axially acquired helical CT images reconstructed in the coronal plane, comparing with coronal helical CT images (direct images) in evaluation of paranasal sinuses.

MATERIAL AND METHODS

The material comprises of a group of 11 patients in which both axial and coronal computed tomography section were acquired. Examination was performed with Somatom Emotion helical CT scanner by Siemens. Scan collimation was 2mm, pitch – 1, recon increment was 1mm. The presence and character of pathology was assessed both on axial and coronal images. Out of axial images a set of coronal MPR reconstructions was performed. Image quality, visibility of pathology and diagnostic value was compared for direct axial section and reconstructed axial images.

RESULTS

Inflammatory changes were seen in 9 patients. In 5 of them polyps in maxillary sinuses were clearly seen on both direct and reconstructed coronal images (Fig. 1AB). Inflammatory mucosal thickening was seen in all of them (Fig. 2AB). In 3 patients the blockage of infundibulum was seen (Fig. 3AB), and that was clearly seen on both direct and reconstructed images. In bone window the Heller cell was seen on the left side, on both direct and reconstructed images (Fig. 4AB). Artifacts from dental amalgam were very intense on direct images, resulting in obscuring the mucosal thickening, easily seen on reconstructed images (Fig. 5AB).

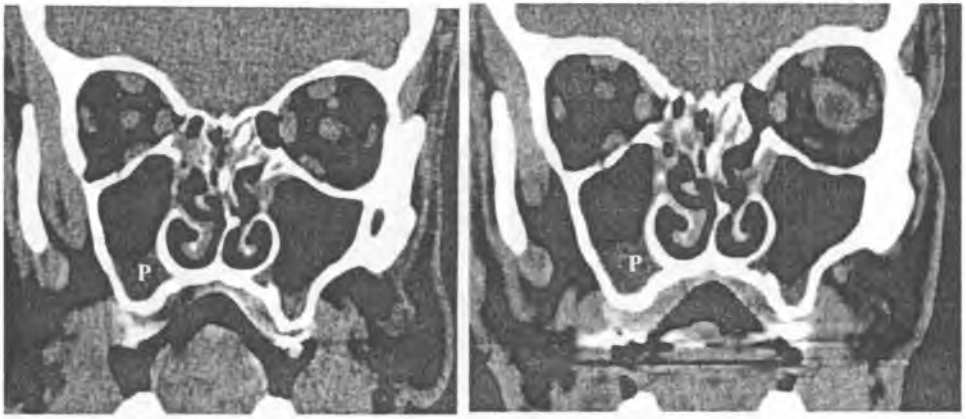

Fig. 1. Polyp in right maxillary sinus (P), inflammatory thickening of the mucosa in the left one; A – direct coronal image. B – reconstructed coronary image

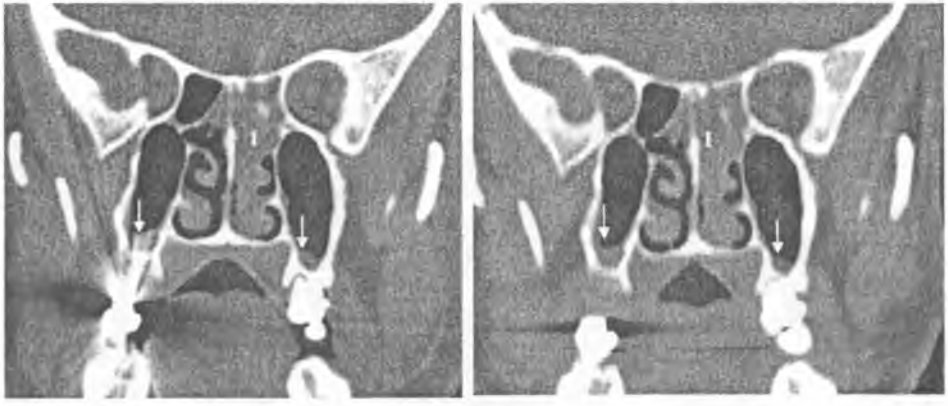

Fig. 2. Inflammatory thickening of the mucosa (I). Mucosal thickening (arrows) seen on both direct (A) and reconstructed coronal images (B)

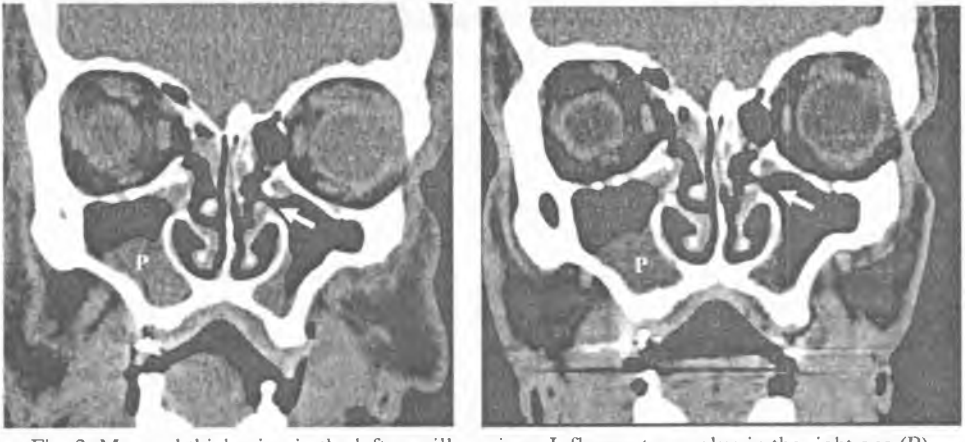

Fig. 3. Mucosal thickening in the left maxillary sinus. Inflammatory polyp in the right one (P). patent infundibulum on the left (arrow), and occluded on the right; A – direct coronal image. B – reconstructed coronary image

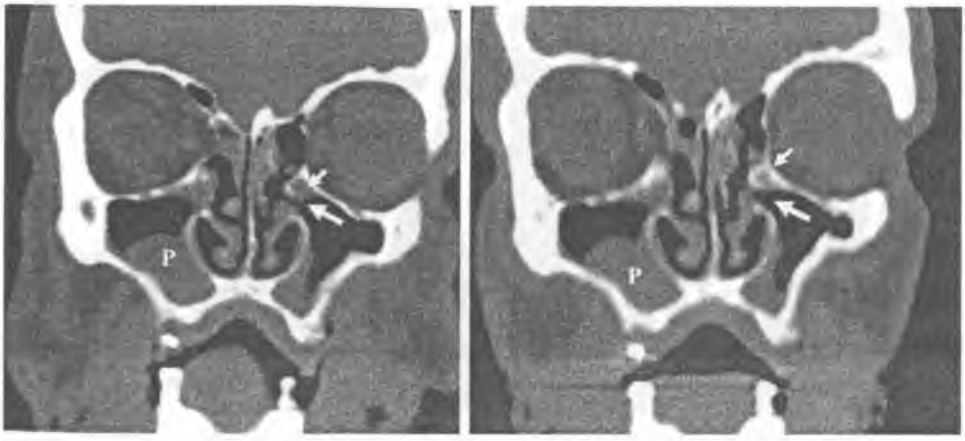

Fig. 4. Bone window of the same sections. Mucosal thickening in the left maxillary sinus. Inflammatory polyp in the right one (P). Patent infundibulum on the left (large arrows), and occluded on the right. Haller cell on the right – small arrows; A – direct coronal image. B – reconstructed coronary image

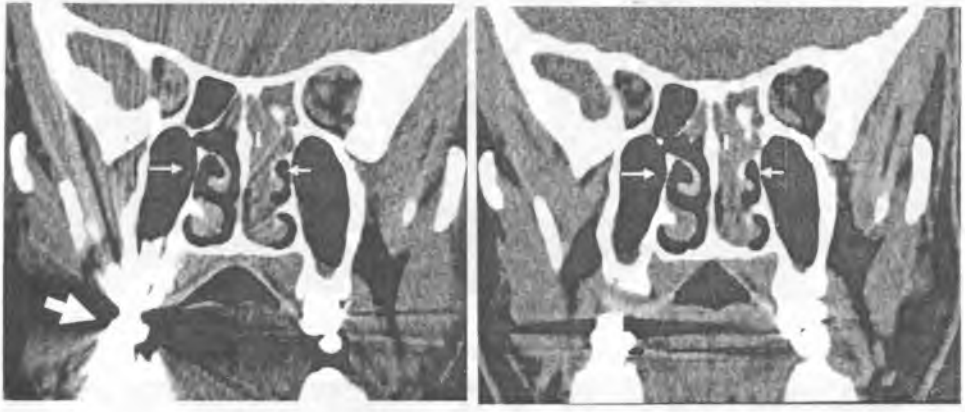

Fig. 5. Intense artifacts from dental amalgam (large arrow) on direct images obscuring the mucosal thickening in the right maxillary sinus (A). Mucosal thickening easily seen bilaterally in maxillary sinuses and in left nasal cavity on reconstructed images (B). Thin bone structures easily seen on both direct and reconstructed images (small arrows)

DISCUSSION

Fiberooptic endoscopic sinus surgery is an effective technique which is increasingly employed in the treatment of sinus disease. Such surgery is not, however, without hazards, particularly if anatomical variations are present (5, 7). Successful endoscopic surgery requires detailed knowledge of the highly variable anatomy of the nasal cavities and paranasal sinuses and their drainage pathways (especially the ostiomeatal unit) as well as the relationship of the diseased areas to vital structures such as the optic nerve and internal carotid artery. CT can accurately and quickly provide this information whilst providing a more accurate assessment of the extent of disease than plain radiographs. CT is, therefore,

widely used in the initial investigation of patients with sinus disease. Radiation dose to the lens of the eye is of concern, especially if CT is used as a screening procedure in patients, many of whom are young (2, 4, 5, 7). Although the radiation dose imparted to the eye during a single CT scan of the sinuses is well below the threshold level believed to induce corneal opacification, there is a theoretical risk of nondeterministic effects, particularly as patients may have multiple imaging (4). The standard sinus radiographs provide information regarding inflammation or tumor. However, for pre-operative diagnosis these are not sufficient because of superimpositions, noted most frequently in ethmoid sinus (1). Direct coronal computed tomography (CT) of sinonasal anatomy displayed by using intermediate window and level settings (window 1700 Hounsfield units [HU], level 300 HU) has been established as the imaging technique of choice for examining patients before functional endoscopic sinus surgery because of its simulation of the surgical orientation, adequate depiction of bony and soft-tissue landmarks, and ability to show disease processes (5).

Helical CT in the coronal scan position is a well established technique for microsurgery of the paransal sinuses. The infundibulum region is easy to view in this position. Septa deviations, blockage of infundibulum, osseous variations of the ethmoid sinus and mucous hyperplasia are better judged in the coronal than in the axial view. But dental fillings and motion produce severe artifacts in coronal scanning, decreasing diagnostic quality. In this respect coronal images have statistically significant poorer diagnostic quality in comparison to axially acquired and carnally reconstructed planes (1). Helical CT acquires data in a continuous fashion, allowing the use of image reconstruction algorithms to produce multiplanar reformatted images. Recent advances in CT technology now permit rapid acquisition of thin section axial CT data in a reasonable amount of time (3). Because helical CT permits rapid volumetric data acquisition, it should permit reconstructions of high quality so that images might only need to be acquired in one plane. Additionally, because helical CT often uses a reduced-milliampere-second technique, radiation exposure for all patients would be reduced (8). CT in at least two orthogonal planes is the standard diagnostic imaging technique for assessing maxillofacial fractures. There are several clinical settings where direct coronal maxillofacial imaging may be desired but cannot be obtained in a timely fashion, such as the multiply injured trauma patient with suspected cervical spine injuries who also may have maxillofacial fractures (6).

Scanning the head in a hyperextend position, which is necessary for coronal images, is particularly difficult for elderly patients; it is often not tolerated and can lead to motion artifacts (1). Adequate assessment of the cribriform plate, orbital roof, orbital floor and planum sphenoidale, structures that are primarily oriented in the axial plane, requires imaging evaluation in the coronal plane. A substantial improvement in patient care could be made if radiologists and clinicians were able to routinely utilize coronal images reformatted from axial images (6).

Helical CT permit the acquisition of thin (1.0–2.0 mm) axial CT sections in a reasonable amount of time, which can then be used to generate good quality coronal reformatted images. The use of reformatted coronal images may be able to replace direct coronal imaging for the evaluation of many patients. High quality of reformatted images makes it possible to use reformatted images in almost any setting in which axial and coronal CT evaluation is necessary (6). Axially acquired helical CT images can be reconstructed in coronal plane within 1–2 minutes. Moreover, gantry tilt is not necessary. Multiplanar reconstructions are possible without prolongation of investigation time. Axially acquired reconstructed images are performed in patients who cannot tolerate the prone position to role out sinusitis. Also, this method is an alternative in patients in whom amalgam generated artifacts would obscure the sinuses in direct coronal images (1). 1mm scan collimation (pitch 1), or 2mm scan collimation (pitch 1) with the 1mm recon increment should reduce step artifacts.

The advantages of axially acquired and coronally reconstructed images are no amalgam and less motion artifact. However, the investigation with coronally acquired images in patients who undergo endoscopic surgery because of tumor or compicated sinusitis is preferred. In patients who cannot maintain this position or with extensive amalgam the examination of the paranasal sinus is performed in the supine position with axially acquired and coronally reconstructed images (1).

CONCLUSIONS

Axially acquired and coronally reconstructed images are of comparable quality with direct coronal images in accessing inflammatory changes and ostiomeatal complex as well. They have some advantages, on such images there are fewer artifacts from dental amalgam, because the scanning position is more acceptable by the patients, fewer motion artifacts occurs. And, moreover, axially acquired reconstructed images can be performed in patients who cannot tolerate the prone position to role out sinusitis.

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SUMMARY

The aim of the study was assessment of the diagnostic value axially acquired helical CT images reconstructed in the coronal plane, comparing with coronal helical CT images (direct images) in evaluation paranasal sinuses. The material comprises a group of 11 patients in which both axial and coronal computed tomography section were acquired. Examination was performed with Somatom Emotion helical CT scanner by Siemens. Scan collimation was 2mm, pitch – 1, recon increment was 1mm. The presence and character of pathology was assessed both on axial and coronal images. Out of axial images set of coronal MPR reconstructions was performed. Image quality, visibility of pathology

and diagnostic value was compared for direct axial section and reconstructed axial images. Inflammatory changes were seen in 9 patients. In 5 of them polyps in maxillary sinuses were clearly seen on both direct and reconstructed coronal images. Inflammatory mucosa thickening was seen in all of them. In 3 patients the blockage of infundibulum was seen, and that was clearly seen on both direct and reconstructed images. In bone window the Heller cell was seen on the left side, on both direct and reconstructed images. Artifacts from dental amalgam were very intense on direct images, resulting in obscuring the mucosal thickening, easily seen on reconstructed images. Axially acquired and coronally reconstructed images are of comparable quality with direct coronal images in accessing inflammatory changes and ostiomeatal complex as well. They have some advantages, on such images there are fewer artefacts from dental amalgam, because the scanning position is more acceptable by the patients, fewer motion artefacts occurs. And moreover axially acquired reconstructed images can be performed in patients who cannot tolerate the prone position to role out sinusitis.

Spiralna TK zatok w płaszczyźnie osiowej, z rekonstrukcjami MPR w płaszczyźnie czołowej, w porównaniu ze spiralną TK zatok w płaszczyźnie czołowej

Celem pracy była ocena wartości diagnostycznej rekonstrukcji czołowych uzyskanych ze skanów czołowych w porównaniu ze skanami czołowymi w ocenie zatok przynosowych. Materiał stanowiła grupa 11 pacjentów, u których wykonano skanowanie w płaszczyźnie osiowej i czołowej skanerem Somatom Emotion firmy Siemens. Kolimacja skanów wynosiła 2 mm, pitch 1, grubość rekonstrukcji 1 mm. Oceniano obecność i charakter patologii na przekrojach osiowych i czołowych. Z zestawu przekrojów osiowych wykonano rekonstrukcje czołowe, na których oceniano obecność i charakter patologii w porównaniu z przekrojami wykonanymi w płaszczyźnie czołowej. Zmiany zapalne stwierdzono u 9 pacjentów. U pięciu z nich stwierdzono obecność polipów w zatokach szczękowych, wyraźnie widocznych zarówno na przekrojach bezpośrednich, jak i na obrazach rekonstruowanych. Zapalne pogrubienie błony śluzowej było widoczne u wszystkich dziewięciu. U trzech stwierdzono zablokowanie kompleksu ujściowo-przewodowego, co uwidoczniono na rekonstrukcjach czołowych oraz na obrazach bezpośrednich. W oknie kostnym stwierdzono obecność komórki Hellera po stronie lewej na obrazach rekonstruowanych i bezpośrednich. Intensywne artefakty z amalgamatu w wypełnieniu zębów na przekrojach czołowych były znacznie mniej intensywne na obrazach rekonstruowanych. Jakość rekonstrukcji czołowych obrazów osiowych jest porównywalna ze skanami bezpośrednimi w płaszczyźnie czołowej w ocenie zmian zapalnych i kompleksu ujściowo-przewodowego. Mamy również pewne korzyści, jest mniej artefaktów wynikających z amalgamatowych wypełnień zębów. Ponieważ pozycja na plecach jest bardziej akceptowalna przez pacjentów, występuje mniej artefaktów ruchowych. Rekonstrukcje czołowe ze skanów osiowych w celu wykluczenia zapalenia zatok mogą być wykonane u pacjentów, którzy nie tolerują pozycji na brzuchu.