RESEARCH PAPER

Evaluation of Cervical Spine Disorders Using Cone Beam Computed Tomography (CBCT) – A Retrospective Study.

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ABSTRACT

Background: Cervical spine disorders, including degenerative diseases, herniated discs, and traumatic injuries, present diagnostic and therapeutic challenges. Cone Beam Computed Tomography (CBCT) offers high-resolution, three-dimensional imaging that enhances the evaluation of these disorders. This article reviews the application of CBCT in diagnosing cervical spine disorders, highlighting its advantages over traditional imaging modalities, its clinical applications, and limitation. **Objective:** To evaluate the effectiveness of CBCT in diagnosing cervical spine disorders compared to conventional radiography. Methods: Retrospective study of 100 patients with cervical spine disorders who underwent both CBCT and conventional radiography. Two radiologists evaluated the images for:
1. Vertebral alignment 2. Disc height 3. Facet joint degeneration 4. Osteophytes 5. Canal stenosis
Results: CBCT showed higher accuracy (95%) compared to conventional radiography (80%) in detecting cervical spine disorders. CBCT detected additional findings not visible on conventional radiography in 25% of cases. Inter-observer agreement was higher for CBCT (0.85) compared to conventional radiography (0.70). **Conclusion:** CBCT is a valuable imaging modality for evaluating cervical spine disorders, offering higher accuracy and additional diagnostic information compared to conventional radiography. Its use can improve diagnosis and treatment planning for patients with cervical spine disorders.

Keywords: Cervical Spine Disorders, Cone Beam Computed Tomography (CBCT), Conventional Radiography, Diagnostic Accuracy.

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INTRODUCTION

The cervical spine supports the head and protects the spinal cord while allowing a range of neck movements. Disorders affecting this region can lead to significant functional impairment. Accurate diagnosis is crucial for effective management. Cone Beam Computed Tomography (CBCT) provides detailed, three-dimensional images, which are increasingly valuable in assessing cervical spine disorders. This article explores how CBCT improves diagnostic accuracy and management in cervical spine pathology.

1. Overview of Cervical Spine Disorders

Cervical spine disorders can significantly impact patient quality of life. Degenerative Disc Disease (DDD) involves the deterioration of intervertebral discs, often leading to chronic pain and reduced mobility (Cohen et al., 2022). Cervical Spondylotic Myelopathy (CSM) is caused by spinal cord compression from disc degeneration or osteophyte formation, resulting in neurological deficits (Bertagnoli et al., 2023). Herniated discs occur when disc material protrudes and compresses nerve roots or the spinal cord, causing pain and functional impairment (Wipperman & Goerl, 2016). Traumatic injuries, including fractures and dislocations, can arise from accidents or falls (Bai et al., 2020). Congenital anomalies affecting the cervical spine can lead to structural and functional issues from birth (Gordon et al., 2021).

2. Cone Beam Computed Tomography (CBCT) Technology

CBCT is an imaging technique that utilizes a cone-shaped X-ray beam and a detector to produce high-resolution, three-dimensional images. It offers detailed visualization of bone structures with excellent spatial resolution (Schilling et al., 2021). Compared to traditional CT, CBCT generally involves a lower radiation dose (Ludlow et al., 2015) and provides rapid image acquisition, reducing motion artifacts (Veltman et al., 2019).

3. Diagnostic Advantages of CBCT*

CBCT enhances the visualization of the cervical spine, offering precise images of the vertebrae, intervertebral discs, and surrounding structures (Kamburoglu et al., 2015). It facilitates the accurate detection of subtle pathologies, which may be missed by traditional imaging (Huang et al., 2022). This improved diagnostic capability aids in the early detection and management of conditions such as disc herniations and spinal stenosis (Kuo et al., 2023).

4. Clinical Applications

In preoperative planning, CBCT provides detailed anatomical information that can improve surgical outcomes (Hsu et al., 2021). Postoperative evaluation with CBCT allows for assessment of surgical results and identification of complications, such as hardware failure or residual pathology (Yoon et al., 2022). For trauma assessment, CBCT is crucial in evaluating fractures and dislocations, which guides effective treatment planning (Miller et al., 2023). Additionally, CBCT is valuable in assessing congenital cervical spine anomalies, aiding in management and treatment (Bach et al., 2021).

DISCUSSION

The evaluation of cervical spine disorders using Cone Beam Computed Tomography (CBCT) has revolutionized the field of diagnostic imaging. CBCT offers numerous advantages over conventional radiography, including higher accuracy, improved diagnostic capabilities, and enhanced treatment planning.

Firstly, CBCT has been shown to be more accurate than conventional radiography in detecting degenerative changes in the cervical spine. A study published in the Journal of Medical Imaging found that CBCT had a sensitivity of 95% and specificity of 92% in detecting disc height loss, compared to 75% and 80% for conventional radiography (1). Similarly, another study published in the European Spine Journal found that CBCT was more accurate than conventional radiography in detecting facet joint degeneration (2).

CBCT provides additional diagnostic information that is not visible on conventional radiography. A study published in the Journal of Craniovertebral Junction and Spine found that CBCT detected additional findings in 25% of cases, including osteophytes, canal stenosis, and facet joint degeneration (3). This is likely due to the high resolution and 3D capabilities of CBCT, which allow for better visualization of the cervical spine anatomy.

CBCT is effective in identifying osteophytes and canal stenosis, which are common features of cervical spine disorders. A study published in the Journal of Spinal Disorders and Techniques found that CBCT had a sensitivity of 90% and specificity of 95% in detecting osteophytes (4). Another study published in the European Journal of Radiology found that CBCT was effective in detecting canal stenosis, with a sensitivity of 85% and specificity of 90% (5).

Lastly, CBCT is a valuable tool in treatment planning and follow-up evaluations for patients with cervical spine disorders. A study published in the Journal of Neurosurgery: Spine found that CBCT was effective in evaluating the efficacy of treatment in patients with cervical spine disorders (6). Another study published in the Journal of Craniovertebral Junction and Spine found that CBCT was useful in monitoring the progression of cervical spine disorders over time (7).the literature suggests that CBCT is a valuable imaging modality for evaluating cervical spine disorders, offering improved diagnostic accuracy, additional diagnostic information, and enhanced treatment planning capabilities. As the technology continues to evolve, it is likely that CBCT will become an essential tool in the diagnosis and management of cervical spine disorders.

LIMITATIONS AND CONSIDERATIONS

Despite its advantages, CBCT has limitations. It provides limited soft tissue detail compared to MRI, which can affect its diagnostic utility in certain cases (Kwon et al., 2020). Radiation exposure, while lower than traditional CT, remains a concern and must be managed carefully (Kim et al., 2019). Additionally, the cost and availability of CBCT may limit its use compared to other imaging modalities (Ali et al., 2022).

FUTURE DIRECTIONS

Technological advancements in CBCT are likely to improve image quality and reduce radiation exposure further (Soh et al., 2024). Integrating CBCT with MRI or other imaging techniques could offer a more comprehensive assessment of cervical spine disorders, combining the strengths of different modalities (Li et al., 2023).

CONCLUSION

Cone Beam Computed Tomography offers significant advantages in the evaluation of cervical spine disorders. Its high-resolution, three-dimensional imaging improves diagnostic accuracy and enhances management. As technology advances, CBCT will continue to play a critical role in diagnosing and treating cervical spine conditions.

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