Computed Tomography for the Diagnosis of Mandibular Invasion Caused by Head and Neck Cancer: A Systematic Review Comparing Contrast-Enhanced and Plain Computed Tomography

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Purpose: To detect the diagnostic efficacy of computed tomography (CT) in distinguishing mandibular invasion caused by head and neck cancer and to compare the accuracy of contrast-enhanced and plain CT in the diagnosis.

Materials and Methods: Studies designed as cohort studies that detected the diagnostic efficacy of CT on mandibular invasion (including bone cortex and bone marrow invasion) and mandibular medullary alone (bone marrow invasion) were included. The included studies were required to use the pathologic diagnosis as the reference standard and reported true-positive, false-positive, false-negative, true-positive, and related data. Thirteen databases were electronically and manually searched to retrieve any possible related studies. Two reviewers independently conducted the study inclusion, data extraction, and assessment of the quality of the included studies. Meta-diSc, version 1.4, and STATA, version 11.0, were used to conduct the meta-analysis.

Results: A total of 30 studies with 1459 patients were included in the present study. Of those patients, 1,257 underwent CT and were accounted for in the meta-analysis. Of the included studies, 1 had a low risk and 6 had a high risk of bias; 23 studies had an unclear risk of bias. Meta-regression showed that the slight clinical heterogeneity did not influence the outcome ($P > .10$). The meta-analysis showed that CT for the diagnosis of mandibular invasion had a pooled sensitivity of 0.72, specificity of 0.90, positive likelihood ratio (+LR) of 5.33, negative likelihood ratio (−LR) of 0.36, diagnostic odds ratio (DOR) of 21.41, area under the curve (AUC) of 0.9022, and Q* (the value of the sensitivity or specificity when the sensitivity equals the specificity on the summary receiver operating characteristics curve) of 0.8336. The CT findings for mandibular medullar invasion had a sensitivity of 0.81, specificity of 0.85, +LR of 4.76, −LR of 0.24, DOR of 29.49, AUC of 0.9240, and Q* of 0.8580. No statistical significance was found in the sensitivity ($P = .809$), specificity ($P = .27$), AUC ($P = .4296$), and Q* ($P = .4277$) between the contrast-enhanced and plain CT scans.

Conclusions: The present clinical evidence has shown that CT had an acceptable diagnostic value in detecting mandibular invasion caused by head and neck cancer. The high specificity of CT predicted it would

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be helpful when it was used to confirm the clinical diagnosis of bone invasion. Contrast-enhanced and plain CT scans had a similar diagnostic efficacy.

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Head and neck cancer has a tendency to invade the mandible because of the anatomic relationships.[1] The presence or absence of mandibular invasion has a great effect on the determination of therapeutics and prognosis.[2] All oncologists know that mandibular invasion caused by head and neck cancer should be assessed before treatment, especially when the patients require surgery. The mandible involvement existence, and the depth and extension of the invasion should be evaluated to determine the cancer stage and the extent of resection necessary before surgery.[3] The preoperative evaluation of mandibular invasion has always consisted of physical examination, imaging studies, and/or biopsy. Of these methods, only the imaging studies can show the details of mandibular invasion.

To date, various imaging modalities have been used for preoperative examinations, most of which have had good diagnostic efficacy in distinguishing mandibular invasion, such as computed tomography (CT),[4] plain radiography,[5] magnetic resonance imaging (MRI),[6,7] orthopanthomography,[8] and positron emission tomography (PET)/CT.[9] However, because none of the imaging diagnostic tools has had 100% accuracy, the method of choice remains controversial.

At present, CT is a commonly used preoperative imaging technique in detecting the stage of head and neck cancer. It can provide multiple key points for treatment planning, such as the tumor extent, metastasis, and depth of infiltration for mandibular invasion when considering the cortical or medullar portion.[10] It is an extremely ideal routine radiologic examination in revealing the bone and soft tissues. However, in some cases, it will be difficult to determine the exact presence and depth of the bone invasion.[11] Thus, many published studies have reported different accuracies for CT in diagnosing mandibular invasion.[12-14] In contrast, routine CT is conducted using contrast-enhanced and plain CT. Because no trials have directly compared these 2 techniques, it is difficult to know which type of CT will be more effective in differentiating mandibular invasion. From 2 clinical controversies, a systematic review is critically important, because it will pool all the trials and conclusions can be drawn from solid outcomes to determine whether CT is an ideal method for detecting bone invasion and which CT type should be chosen. Therefore, the present systematic review aimed to detect the diagnostic efficacy of CT in distinguishing mandibular invasion caused by head and neck cancer and to compare the accuracy of contrast-enhanced and plain CT scans in its diagnosis.

Materials and Methods

Because ours was a systematic review, it was granted an exemption by the local institutional review board. During the study process, all the reviewers followed the guidelines of the Declaration of Helsinki.

INCLUSION CRITERIA

The inclusion criteria were as follows. First, the study types were diagnostic test accuracy studies designed as cohort studies. Second, the participants were patients diagnosed with head and neck cancer with preoperative biopsy and mandibulectomy during surgery. Third, the index test was contrast-enhanced or noncontrast-enhanced CT. Fourth, the reference standard had to have been the pathologic diagnosis. Finally, the outcomes had to have recorded the true-positive (TP; number of patients diagnosed with bone invasion by CT and proved by pathologic examination), false-positive (FP; number of patients diagnosed with bone invasion by CT not proved by pathologic examination), false-negative (FN; number of patients with no bone invasion by CT, but proved to have bone invasion by pathologic examination), and true-negative (TN; number of patients with no bone invasion by CT and proved by pathologic examination) results, or other statistical data that could help calculate these outcomes. All these data were used to calculate the sensitivity (proportion of TP results), specificity (proportion of TN results), positive likelihood ratio (+LR), and negative likelihood ratio (−LR).

SEARCH STRATEGY

To find all the related studies, both electronic and manual searches were conducted. The bibliographic databases that were electronically searched included the Cochrane Oral Health Group's Trials Register (to issue 4, 2012), Cochrane Central Register of Controlled Trials (CENTRAL, using the Cochrane Library, to issue 11, 2012), MEDLINE (using OVID, 1948 to November 25, 2012), EMBASE (using OVID, 1980 to November 25, 2012), Cumulative Index for Nursing and Allied Health Literature (using EBSCO, 1980 to November 25, 2012), Latin American and Caribbean Health Sciences (using BIREME, 1980 to November 25, 2012), Chinese BioMedical Literature Databases (1978 to November 25, 2012), China National Knowledge Infrastructure (1994 to November 25, 2012), VIP database (1989 to November 25, 2012), and Wangfang database (1998 to November 25, 2012). "Gray literature" was