Role of Ultrasonography in Differentiating Facial Swellings of Odontogenic Origin

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Abstract

Introduction: Differentiating an acute, odontogenic facial swelling clinically as cellulitis or an abscess has not been thoroughly investigated in endodontics. It has been suggested in the medical and dental literature that the use of ultrasound may aid in differentiating cellulitis from an abscess. Therefore, if ultrasound were more accurate than a blind incision for drainage procedure in locating purulence, perhaps the outcome of the incision for drainage procedure would be beneficial in the resolution of odontogenic infections. The purpose of this prospective study was to compare clinical examination plus ultrasonography versus clinical examination alone in differentiating cellulitis from abscesses in patients with facial swelling of odontogenic origin. **Methods:** Eighty-two emergency patients participated in this study. Each patient was examined and diagnosed by clinical examination and clinical examination plus ultrasonography. An incision for drainage procedure was performed, and a definitive diagnosis was recorded as cellulitis (no purulence) or an abscess (presence of purulence). **Results:** With the incision for drainage procedure, cellulitis occurred 37% of the time and abscesses 63%. With clinical examination alone, a correct diagnosis was made 68% of the time. With clinical examination plus ultrasonography, a correct diagnosis was made 70% of the time. There was no statistically significant difference between the 2 examination methods. **Conclusions:** The addition of ultrasonography to a clinical examination did not significantly increase the number of correct diagnoses. *(J Endod 2014;40:495–498)*

Key Words

Abscesses, cellulitis, facial, symptomatic necrotic teeth, ultrasound

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In endodontics, patients presenting with facial swelling is a common emergency occurrence (1). Differentiating an acute, odontogenic facial swelling clinically as cellulitis or an abscess has not been thoroughly investigated in endodontics. Swelling that spreads through adjacent soft tissue and dissects tissue spaces along fascial planes is considered to be diffuse swelling or cellulitis (2). Cellulitis can be the initial presentation of an acute process and often presents with swelling, erythema, and tenderness over the affected area. The borders of cellulitis may be ill defined, and the swelling is not purulent. An abscess is localized and characterized by the sensation on palpation that there is fluid movement under the tissue, indicating purulence (2). Some authors have stated that an abscess must be drained surgically and that cellulitis responds to systemic antibiotics (3–5). Others have suggested draining both cellulitis and an abscess (2, 6–9). The 2 conditions may also coexist because an abscess often begins as cellulitis.

It has been suggested in both the medical and dental literature that the use of ultrasonography can aid in the diagnosis of swellings and also in locating the depth of the purulence to allow a more accurate location for an incision and drainage procedure over the traditional blind procedure (3, 4, 10–18). A review article by Ramirez-Schrempp et al (5) stated that ultrasound is an efficient, noninvasive diagnostic tool that can augment the physician's clinical examination. Ultrasound has been shown to be superior to clinical judgment alone in determining the presence or absence of occult abscess formation, ensuring appropriate management.

There have been studies and case reports in the medical literature using ultrasound-guided aspiration and irrigation techniques to locate and treat breast, thyroid, and prostate abscesses over the traditional, blind surgical drainage technique (12–16). Ultrasound has also been used to aid in the diagnosis of odontogenic swellings (4, 10, 18, 19) and to differentiate between cellulitis and an abscess (3, 17). Squire et al (3) found the sensitivity of ultrasound examination for an abscess was 98% and specificity was 88%. Of the 107 patients with a superficial subcutaneous abscess, 64 had an incision for a drainage-proven abscess, 17 did not have a proven abscess with an incision for drainage, and 26 improved with only antibiotics (no incision and drainage) (3). In a study of patients with soft tissue swellings of the head and neck, Siegert (18) found a sensitivity with ultrasound of 82% versus clinical examination of 69%. The specificity of ultrasound was 86% and 71% for clinical examination. Adhikari et al (19) reviewed records of emergency patients with odontogenic problems and found the sensitivity and specificity of ultrasound to diagnose a dental abscess were 92% and 100%, respectively. Therefore, if ultrasound were more accurate than a blind incision for drainage procedure in locating purulence, perhaps the outcome of the incision for drainage procedure would be beneficial in the resolution of odontogenic infections.

Bassiony et al described the echogenecities of ultrasound in comparison with adjacent tissues as hyperechoic (brighter), isoechoic (equal), hypoechoic (darker), anechoic (no internal echoes), or mixed (10). Normal skin has a very organized pattern where the dermis and epidermis appear as a single hyperechoic layer (bright layer) relative to the subcutaneous tissue, which is hypoechoic (10). Bassiony et al (10) also staged infections as a cellulitis phase or abscess phase. In cellulitis, the tissues were described as hyperechoic (commonly referred to as cobblestoning) (Fig. 1) because of the massive inflammatory infiltration in the infected region. In the abscess stage, the echogenicity of the tissues showed an anechoic or hypoechoic mass containing the

Figure 1. Ultrasound image of cellulitis (cobblestoning).

abscess cavity (Fig. 2). This cavity can be solitary or have multiple well-defined foci of purulence. In some cases, swirling of the purulence may be observed. The use of color Doppler imaging allows visualization of a vascular or neural structure (like the mental nerve) so it can be avoided during the incision for the drainage procedure. However, there is the added expense of an ultrasound unit ($20,000–$30,000) to the procedure.

The use of ultrasound in differentiating cellulitis from an abscess has not been thoroughly investigated. The purpose of this prospective study was to compare clinical examination plus ultrasonography versus clinical examination alone in differentiating an abscess from cellulitis in patients with facial swelling of odontogenic origin.

Materials and Methods

Eighty-two adults participated in this study. All were emergency patients of the College of Dentistry and were in good health as determined by a health history and oral questioning. Subjects who were younger than 18 years, allergic to local anesthetics or sulfites, pregnant or nursing, had a history of significant medications (American Society of Anesthesiologists class III or higher), or were unable to give informed consent were excluded from the study. Patients were also excluded if the swelling was thought to require airway management and/or hospitalization. Approval for performing this study was granted by The Ohio State University Human Subjects Review Committee, and written informed consent was obtained from each patient.

All patients presented with an inflammatory reaction to pulpal infection and necrosis characterized by rapid onset, spontaneous pain, tenderness of the tooth, possible pus formation, and swelling of associated tissues. All patients presented with facial swelling and pain. Only patients with swelling related to an odontogenic cause participated. A pulpal diagnosis of necrosis was verified by no response to testing with Green Endo-Ice (Hygenic Corp, Akron, OH) or an electric pulp tester (Analytic Technology, Redmond, WA). Patients had their temperatures taken orally using the SureTemp digital thermometer (Welch Allyn Ltd, Navan, CO) to determine a possible fever. Normal temperature has been reported to be 98.6°F, and a temperature at or above 98.9°F would define a fever (20). Therefore, patients with a temperature of 98.9°F or higher were considered to have a fever. Patients also rated their level of preoperative pain using the Heft-Parker visual analog scale (21). This 170-mm scale was divided into 4 sections according to levels of pain. A score of 0 mm indicated the patient was feeling no pain. Greater than 0 mm and less than or equal to 54 mm indicated mild pain. Within the mild pain range, the descriptors of faint, weak, and mild pain were incorporated. A score between 54 mm and 114 mm indicated moderate pain with the descriptor moderate included. Equal to or greater than 114 mm up to and including 170 mm indicated severe pain, with the descriptors of strong, intense, and maximum possible included in this range.

Figure 2. Ultrasound image of fluctuance (anechoic area).

Swelling was clinically examined intraorally and extraorally by digital palpation to determine if it was cellulitis or an abscess. A diagnosis of cellulitis was made if the swelling was firm, warm, or hot, and no observable fluid movement (purulence) was detected. An abscess was diagnosed if there was believed to be fluid movement under the tissue, indicating purulence was present.

The swelling was then evaluated using the portable Acuson p50 ultrasound unit (Siemens, Munich, Germany), which produced high-resolution images. The transducer used was the 12L5 linear wideband array transducer. It had a maximum depth of 80 mm and a frequency range of 4.8–12.0 MHz. A radiology technician, who trains medical radiologists to use the ultrasound machine, trained the principal author (LP) to determine the best settings to capture images of an abscess and/or cellulitis in facial swellings. An oral and maxillofacial radiologist was also involved in its clinical use on patients with swelling. A custom examination was developed to view soft tissue swellings of the head and neck and was based closely on the preset examination parameters of the thyroid and breast. Each patient's swelling was viewed in 2-dimensional and Doppler modes. The 2-dimensional mode used 256 digital beamforming channels to display 2-dimensional images of the anatomy in a gray color scheme. The color Doppler mode was useful in identifying vessels and blood flow near and/or within the swelling. Images were captured and saved. Loop images or videos were captured if swirling of purulence was observed.

After the clinical examination, the 12L5 ultrasonic transducer was moved over the entire extraoral swelling. All the swellings were on the facial or buccal aspects of the teeth (Table 1). It was not possible to use the sonography unit in the floor of the mouth or deep fascial spaces because of limited access of the ultrasonic probe. A water-based gel (Aquasonic Gel; Parker Lab Inc, Fairfield, NJ) was used as the medium between the transducer and the patient's skin to eliminate air bubbles. Slight pressure was applied, and patients were asked to report where the swelling was most tender. Once the ultrasound examination was complete, a diagnosis of cellulitis or an abscess was made and recorded. Cellulitis showed thickening and diffuse hyperechogenicity commonly referred to as cobblestoning (10) (Fig. 1). The abscess showed an anechoic or hypoechoic mass (Fig. 2). Compression of the mass with the transducer in some cases showed movement or swirling of fluid.

After administration of local anesthesia and using the results of the sonographic examination, another investigator performed the incision for drainage procedure. The principal investigator (LP) was present to