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Abstract

Objectives: Investigate the use of nasal endoscopy, sinus imaging, and neurologic evaluation in patients presenting to a rhinologist primarily for craniofacial pain.

Methods: This was a retrospective analysis of consecutive outpatients presenting to a rhinologist between 2016 and 2019 with chief complaints of craniofacial pain with or without other sinonasal symptoms, who were then referred to and evaluated by headache specialists. Data analyzed included sinusitis symptoms, Sino-Nasal Outcome Test (SNOT-22) scores (and facial pain subscores), pain location, nasal endoscopy, computed tomography (CT) findings, and headache diagnoses made by headache specialists.

Results: Of the 134 patients with prominent craniofacial pain, the majority of patients were diagnosed with migraine (50%) or tension-type (22%) headache, followed by multiple other non-sinogenic headache disorders. Approximately 5% of patients had headaches attributed to sinusitis. Amongst all patients, 90% had negative nasal endoscopies. Patients with negative endoscopies were significantly less likely to report smell loss ($P = .003$) compared to those with positive endoscopies. Poor agreement was demonstrated between self-reported pain locations and sinus findings on CT (kappa values < 0.20). Negative nasal endoscopy showed high concurrence with negative CT findings (80%-97%).

Conclusions: Patients presenting with chief complaints of craniofacial pain generally met criteria for various non-sinogenic headache disorders. Nasal endoscopy was negative in 90% of patients, and CT demonstrated poor agreement with pain locations. Nasal endoscopy and CT shared high concurrence rates for negative sinus findings. The value of nasal endoscopy over sinus imaging in craniofacial pain evaluation should be explored in future studies.

Keywords
facial pain, headache, sinusitis, nasal endoscopy

Introduction

Craniofacial pain, sometimes referred to as "sinus headache," is one of the most common reasons for outpatient otolaryngology referrals,[1-3] and represents a diagnostic and therapeutic challenge. Despite decades of literature highlighting that "sinus headache" is a misnomer, many patients and clinicians continue to use the term.[4-7] Unfortunately, this reinforces the inaccurate presumption that craniofacial pain is often due to sinus disease despite many studies demonstrating that facial pain is most often due to non-sinogenic headache disorders.[7-13]

Otolaryngology and neurology guidelines on rhinosinusitis and headache, respectively, convey messages that are somewhat discrepant from many original research studies demonstrating a low prevalence of rhinosinusitis as a cause of craniofacial pain. For example, the 2015 adult sinusitis guidelines reported facial pain or pressure as being the second most common symptom of chronic rhinosinusitis (CRS).[14] In 2018 the International Headache Society published the third edition of the International Classification of

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Headache Disorders (ICHD-3), including criteria for 2 forms of headache that may be attributed to rhinosinusitis: (1) pain caused by acute rhinosinusitis (ARS) in the setting of active infection, and (2) pain caused by CRS with evidence of current or recent infection or inflammation.[15] There were 2 main issues with these guidelines with regard to craniofacial pain. First, neither discussed findings from numerous studies demonstrating that non-sinogenic headache disorders as causing craniofacial pain more often than ARS and CRS. Second, neither provided clear recommendations for deducing whether craniofacial pain is or is not attributable to sinonasal inflammation or infection.

Multiple studies have reported on different modalities to diagnose non-sinogenic facial pain,[9,16-19] but there remains no clear consensus on an optimal approach. Until reliable diagnostic measures are established for confirming or refuting rhinosinusitis as a cause of facial pain, patients may be misdiagnosed as having rhinosinusitis, leading to inappropriate medical and sometimes surgical interventions, increased healthcare costs, and prolonged patient suffering.[1,11,12,20,21] The purpose of this study was to report clinical features and headache diagnoses of patients presenting to a rhinologist for chief complaints of craniofacial pain.

Materials and Methods

A single-center retrospective analysis was conducted on consecutive outpatients who presented to a rhinologist (JRC) with chief complaints of craniofacial pain between January 2016 and December 2019. Patients were self-referred or clinician-referred. The study was approved by the Henry Ford Health Institutional Review Board. Patients were first evaluated by the rhinologist via history, physical examination, and nasal endoscopy, with or without sinus computed tomography (CT) or magnetic resonance imaging (MRI). When the most significant complaint reported to the rhinologist was craniofacial pain, patients were always referred to United Council for Neurologic Subspecialties certified headache specialists, whether or not they were diagnosed with infectious or inflammatory rhinosinusitis. Patients were excluded if they had sinonasal tumors or invasive fungal sinusitis, or a history of any sinonasal, facial, or brain surgery within 6 months of evaluation.

Data captured through electronic medical record review of the rhinologist's office notes included cardinal sinusitis symptoms,[14] Sino-Nasal Outcome Test (SNOT-22) scores (and facial pain subscore), craniofacial pain location(s), and nasal endoscopy findings. Some patients underwent sinus CT scans either before or after rhinologic evaluations. Neuroimaging via head CT or MRI was obtained for patients meeting specific headache criteria.[22]

Craniofacial pain locations included cheek, forehead, between eyes, external nasal, orbital/periorbital, retrobulbar, whole face (V1-V3), and whole scalp. All locations were assessed by laterality (left, right, or bilateral). Nasal endoscopy was considered positive if mucopurulence, edema, or polyps were identified in the middle meatus, superior meatus, or sphenoethmoid recess. Endoscopic findings were also coded by laterality (left, right, or bilateral).

CT scans were analyzed if all the paranasal sinus walls could be evaluated, if they were obtained within 3 months of nasal endoscopies, and if they were performed over 6 months after any sinonasal surgery. Maxillary, anterior ethmoid, posterior ethmoid, sphenoid, and frontal sinuses were assessed individually on left and right sides. If any sinus was suboptimally visualized on CT, its grading was omitted. Scans were reviewed by 3 of the authors to reach grading consensus (AMP, FY, and JRC). Sinus imaging findings were coded as negative if there was no sinus opacification, if there was focal mucosal thickening occupying <50% of sinus walls, or for isolated mucus retention cysts. Sinus imaging findings were considered positive if there was partial to complete sinus opacification, or mucosal thickening occupying >50% of sinus walls. Mucosal contact points, deviated nasal septum, concha bullosa, and allergic rhinitis were not analyzed.

Headache diagnoses were made by headache specialists based on ICHD versions 3-beta or 3.[15,23] It should be noted that headache due to sinusitis was diagnosed only after evaluations by both the rhinologist and headache specialists. The diagnosis was made when craniofacial pain was congruent to sinusitis confirmed either by positive nasal endoscopy alone, CT/MRI, or both endoscopy and CT/MRI. The specific type of sinus disease causing the pain was diagnosed by the rhinologist based on established criteria.

Statistical analyses were performed with SAS Version 9.4 (SAS Institute, Cary, NC). Demographic data and descriptive statistics were calculated. Associations were assessed by chi-squared tests for nominal variables, and 2-sample Wilcoxon tests for continuous variables. When correcting for multiple comparisons, a Bonferroni correction was used.

First, associations between nasal endoscopy findings and sinusitis symptoms were assessed. Next, concurrence rates between negative nasal endoscopies and negative CT findings were calculated. Findings were considered concurrent if patients had negative endoscopies and negative CT findings in the sinuses corresponding to the endoscopically visualized drainage pathways on left and right sides (eg, middle meatal endoscopic findings were compared to CT findings in the maxillary, anterior ethmoid, and frontal sinuses; superior meatal findings to the posterior ethmoid sinuses; and sphenoethmoid recess findings to the sphenoid sinuses). Figure 1 illustrates an example of how concurrence was assessed between the middle meatus endoscopically and the maxillary, anterior ethmoid, and frontal sinuses on CT.

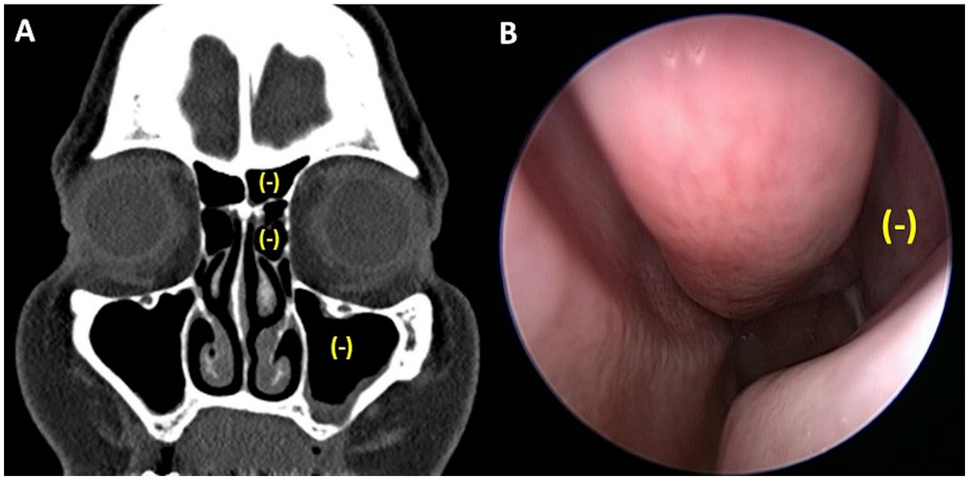

Figure 1. Example of how concurrence of negative findings was assessed between (A) left maxillary, anterior ethmoid, and frontal sinuses on computed tomography, and (B) left-sided middle meatal endoscopy. (-) Connotes grades of "negative" for the given diagnostic modality.

Statistical agreement was also assessed between locations of facial pain and sinus findings on CT using Cohen's kappa coefficient.[24] Cheek pain was compared to maxillary sinus findings, forehead pain to frontal sinus findings, pain between eyes to ethmoid sinus findings, and retrobulbar pain to sphenoid sinus findings.

Results

There were 134 consecutive patients who presented with chief complaints of craniofacial pain, 60 of whom had CT scans for review. Mean age was 50.5 years, and 74.6% were female. Figure 2 shows the frequencies of headache disorders diagnosed by headache specialists, the majority being migraine (50%) and tension-type headache (21.6%). None of the patients diagnosed with primary headache conditions were diagnosed with concurrent sinus disease during the study period. Only 5.2% of patients (7/134) had headache attributed to rhinosinusitis, with rhinosinusitis being confirmed by nasal endoscopy plus CT in 5 patients, and CT alone in 2 patients with negative nasal endoscopies. Sinusitis types causing craniofacial pain included 3 CRS without nasal polyps, 2 CRS with nasal polyps, 1 odontogenic sinusitis, and 1 sphenoid sinus fungal ball. None of these 7 patients had concurrent primary headache disorders.

Table 1 shows the frequencies of craniofacial pain locations. Most common pain locations were maxillary (54%) and frontal (50%), with 41.8% of patients reporting pain at multiple sites. The majority of patients (67.2%) reported bilateral or midline pain. Pain was unilateral in 32.8% of patients, with roughly equal percentages of left-sided (15.7%) and right-sided (17.2%) pain.

Figure 3 shows frequencies of headache diagnoses made by headache specialists, in patients with unilateral facial pain, with migraine being most common. Two patients had headache attributed to unilateral sinus disease, 1 was a sphenoid sinus fungal ball and 1 odontogenic sinusitis.

Table 2 shows frequencies of sinonasal symptoms and mean SNOT-22 and facial pain scores, as well as associations between endoscopy and symptom findings. Facial pain occurred alone in only 30.6% of patients. Nasal obstruction was the most prevalent concurrent symptom in 42.5% of patients, followed by posterior nasal drainage (33.6%), anterior nasal drainage (31.3%), and smell loss (11.2%). Nasal endoscopies were negative in 90.3% (121/134) of patients. Patients with negative endoscopies were less likely to have smell loss compared to patients with positive endoscopies (8.3% vs 38.5%, $P = .003$). For isolated facial pain, the increased likelihood of negative endoscopy trended toward significance ($P = .065$). Mean SNOT-22 score was 45 ± 22, with a mean facial pain score of 3.7 ± 1.3. There were no significant differences in SNOT-22 or facial pain scores between positive and negative endoscopies.

Table 3 shows the frequencies of positive and negative sinus findings on CT, on left and right sides for each sinus. Negative findings were demonstrated in the overwhelming majority of sinuses (72%-97%). Table 4 shows that agreement ranged from none to slight between facial pain location and sinus CT findings (all kappa values < 0.20).

Table 5 shows concurrence rates between negative nasal endoscopies and sinus CT findings. There were high concurrence rates of 80% to 97% when comparing maxillary, ethmoid, sphenoid, and frontal sinus CT findings to

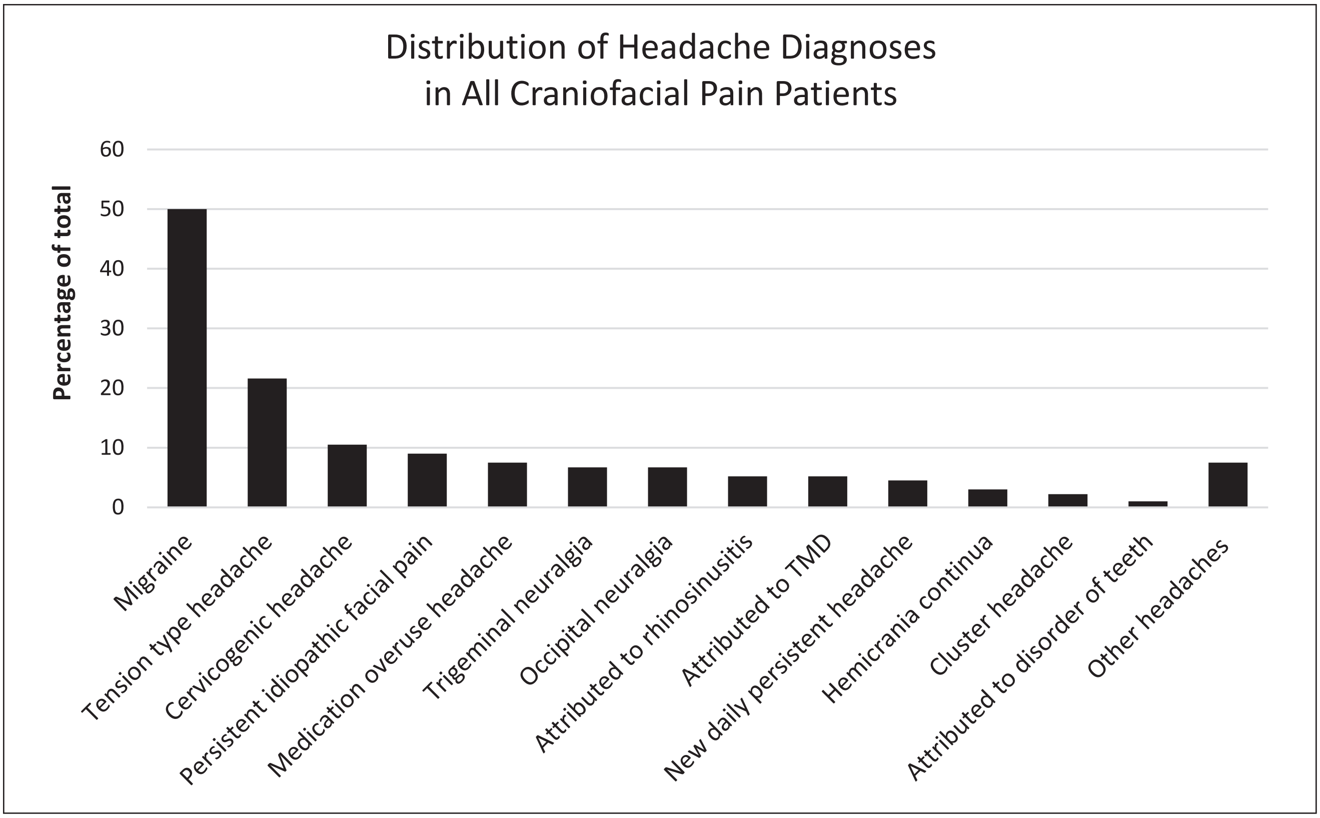

Figure 2. Distribution of headache diagnoses in all craniofacial pain patients. Note that percentages of headache diagnoses sum to over 100% due to some patients having multiple headache diagnoses. The category of "migraine" includes episodic migraine, with and without aura, chronic migraine, and other migraine subtypes.
Abbreviation: TMD, temporomandibular disorder.

Table 1. Frequencies of Craniofacial Pain Locations.

Pain location	Frequency % (N/134)
Anatomic subsite	
Cheek	54.5 (73)
Frontal/forehead	50.0 (67)
Orbital	28.4 (38)
Generalized head	16.4 (22)
Retrobulbar	14.2 (19)
Nasal	13.4 (18)
Temple	11.9 (16)
Glabella	4.5 (6)
Whole face	1.5 (2)
Laterality	
Left	15.7 (21)
Right	17.2 (23)
Bilateral/Midline	67.2 (90)

Note. Note that percentages of anatomic locations sum to over 100% due to some patients having multiple pain locations.

endoscopies of their respective drainage pathways. No kappa coefficient was calculated due to the low frequency of positive endoscopy and CT findings.

Discussion

The overwhelming majority of patients in the current study presenting with chief complaints of craniofacial pain were ultimately diagnosed with headache disorders, with only 5% having headache attributed to sinusitis. Despite prior studies showing that craniofacial pain frequently represents a non-sinogenic headache disorder, both patients and clinicians still often presume a close causal relationship between sinusitis and facial pain. For example, previous studies have demonstrated a high prevalence of migraine in 70% to 90% of presumed sinus headaches.[7,8,11,12] More recent studies have still shown migraine to be the most common cause of sinus headaches, but with a 40% to 60% prevalence,[9,10,25] similar to the current study. This highlights that the differential diagnosis for craniofacial pain encompasses a broader spectrum of headache disorders than migraine alone, so neurologic evaluation by headache specialists with subspecialty training and expertise on headache criteria should improve diagnostic accuracy for the cause of patients' pain.

One significant issue in determining the cause of craniofacial pain is that sinusitis and headache clinical features

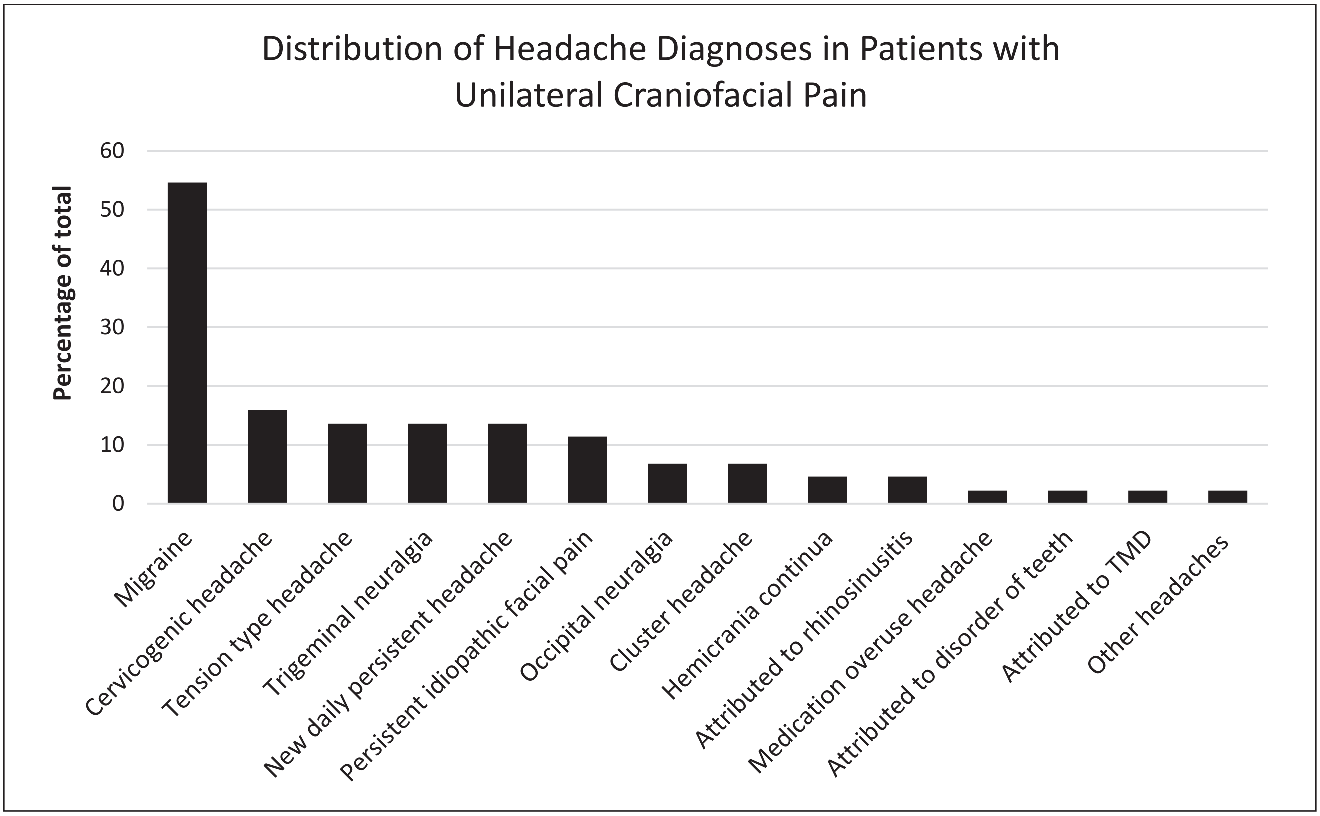

Figure 3. Distribution of headache diagnoses in patients with unilateral craniofacial pain. Note that percentages of headache diagnoses sum to over 100% due to some patients having multiple headache diagnoses. The category of "migraine" includes episodic migraine, with and without aura, chronic migraine, and other migraine subtypes.
Abbreviation: TMD, temporomandibular disorder.

Table 2. Symptom Frequencies and SNOT-22 Scores in Craniofacial Pain Patients.

Symptoms	Frequency % (N/134)	Negative endoscopy % (N/121)	Positive endoscopy % (N/13)	Comparing between negative and positive endoscopies (*P*-values)
Nasal obstruction	42.5 (57)	35 (47)	76.9 (10)	.016
Smell loss	11.2 (15)	8.3 (10)	38.5 (5)	**.003**
Facial pain (alone)	30.6 (41)	33.1 (40)	7.7 (1)	.065
Anterior drainage	31.3 (42)	28.9 (35)	53.9 (7)	.078
Posterior drainage	33.6 (45)	32.2 (39)	46.2 (6)	.339
SNOT-22 Scores	Mean ± SD	Mean ± SD	Mean ± SD	
SNOT-22	45.0 ± 22.2	44.8 ± 22.5	47.9 ± 20.6	.632
Facial pain (Item 12)	3.7 ± 1.3	3.8 ± 1.3	3.6 ± 1.9	.647

Note. Bold *P*-values represent statistically significant results based on Bonferroni correction ($P < .0071$).
Abbreviations: SD, standard deviation; SNOT-22, Sino-Nasal Outcome Test.

overlap substantially. First, various headache disorders cause cheek, forehead, and retrobulbar pain, which can be mistaken for sinus pain.[7,26-28] Second, cranial autonomic symptoms like rhinorrhea and nasal obstruction are highly prevalent in certain headache conditions, especially migraine and cluster headache,[7,29] so these headaches may be falsely attributed to sinusitis. Third, some migraine triggers include seasonal or barometric pressure changes, as well as allergen exposure,[7] and subsequent migraine symptoms may be interpreted as sinusitis. Lastly, some studies have shown that up to a third of facial pain patients can have both rhinosinusitis and non-sinogenic headache disorders,[9]

Table 3. Frequencies of Imaging Findings in Each Sinus on Computed Tomography Scans When All Sinus Walls Could Be Visualized.

	Maxillary		Anterior Ethmoid		Posterior Ethmoid		Sphenoid		Frontal	
	Left % (N/43)	Right % (N/43)	Left % (N/59)	Right % (N/59)	Left % (N/59)	Right % (N/59)	Left % (N/59)	Right % (N/59)	Left % (N/51)	Right % (N/52)
0/1	79.1 (34)	72.1 (31)	79.7 (47)	83.1 (49)	84.7 (50)	89.8 (53)	91.5 (54)	96.6 (57)	90.2 (46)	96.2 (50)
0	41.9 (18)	32.6 (14)	57.6 (34)	57.6 (34)	71.2 (42)	67.8 (40)	78.0 (46)	79.7 (47)	74.5 (38)	71.2 (37)
1	37.2 (16)	39.5 (17)	22.0 (13)	25.4 (15)	13.6 (8)	22.0 (13)	13.6 (8)	16.9 (10)	15.7 (8)	25.0 (13)
2	20.9 (9)	27.9 (12)	20.3 (12)	16.9 (10)	15.3 (9)	10.2 (6)	8.5 (5)	3.4 (2)	9.8 (5)	3.8 (2)

Abbreviations: 0, no sinus opacification or mucosal thickening; 1, mucosal thickening <50% of sinus walls, or isolated mucus retention cysts; 2, partial to complete opacification, or mucosal thickening >50% of sinus walls.

Table 4. Agreement Between Craniofacial Pain Locations and Sinus Findings on Computed Tomography (CT).

Side of pain	Maxillary sinus on CT versus cheek pain kappa (95% CI)	Frontal sinus on CT versus forehead pain kappa (95% CI)	Ethmoid sinus on CT versus pain between eyes kappa (95% CI)	Sphenoid sinus on CT versus retrobulbar pain kappa (95% CI)
Left	0.094 (−0.170 to 0.357)	0.006 (−0.196 to 0.208)	n/a	0.095 (−0.232 to 0.423)
Right	0.255 (−0.024 to 0.534)	0.015 (−0.114 to 0.144)	n/a	−0.060 (−0.128 to 0.009)
Bilateral	0.174 (−0.062 to 0.410)	0.025 (−0.125 to 0.176)	−0.061 (−0.133 to 0.011)	−0.049 (−0.098 to 0.001)

Abbreviations: CI, confidence interval; n/a, not applicable.

making it challenging to distinguish which condition is causing the headache.

Another problem lies with the reported frequency with which sinusitis causes craniofacial pain. Some studies report significant facial pain in CRS[30] and ARS,[31] while others demonstrate low facial pain rates.[13,32,33] Given these mixed findings, diagnostic criteria in sinusitis guidelines specify that facial pain alone is insufficient to diagnose rhinosinusitis, unless there is either concurrent nasal obstruction or drainage (anterior or posterior).[14,34] Another significant issue then is that diagnosing rhinosinusitis based on symptoms alone suffers from low positive and negative predictive values of 50% to 70%.[35] Interestingly, based on the current study's findings and sinusitis guidelines to date, 66.4% patients (89/134) met symptomatic criteria for rhinosinusitis. However, 87.4% of those patients (78/89) had negative endoscopies, highlighting the importance of objective evaluation of sinusitis regardless of symptoms.

Regarding objective testing, whether sinus imaging or nasal endoscopy is more effective for evaluating facial pain is debatable. Sinus CT has been considered the gold standard for evaluating rhinosinusitis and has received more attention in the literature for evaluating facial pain. Interestingly, numerous studies have demonstrated significant limits of sinus imaging that negatively impact facial pain evaluations. First, multiple studies have shown a high prevalence of incidental sinus abnormalities on 15% to 42% of head/sinus CTs,[36-38] and 30% to 85% of MRIs.[36,39] More specifically, patients undergoing CT for non-sinogenic headaches have abnormal sinus findings in 29% to 80% of cases.[9,11,37] Additionally problematic, 2 studies have assessed patients with rhinosinusitis and facial pain, both demonstrating poor correlations between pain location and site or severity of sinus disease on CT.[19,40] Similarly, the current study demonstrated poor agreement between reported pain sites and sinus disease on CT. Due to the high rates of incidental findings on CT and MRI, and poor correlation between pain location and sinus disease on imaging, sinus imaging is of limited utility when evaluating craniofacial pain.

Compared to CT, nasal endoscopy has received less attention, but may be more effective for evaluating rhinosinusitis and facial pain. A recent meta-analysis showed that nasal endoscopy sufficed to confirm or refute CRS, without the need for CT in most cases.[41] In the setting of craniofacial pain, certain findings on nasal endoscopy may aid in confirming the pain is due to rhinosinusitis. For example, some studies have shown facial pain to be more likely in purulent sinusitis, whether it be ARS, acute exacerbations of CRS, or odontogenic sinusitis.[17,31,32,42] ICHD-3 criteria also specify that headache attributed to ARS is more likely if purulent secretions are noted concurrently.[15] Whether endoscopic findings of infection or inflammation are truly indicative of facial pain requires further study, but these findings are readily identifiable on examination, and this could help in establishing an association between pain and rhinosinusitis.

Conversely, negative findings on nasal endoscopy may be even more useful than positive findings when evaluating facial pain. Kieff and Busaba demonstrated a 90% negative

Table 5. Concurrence Rates Between Negative Findings on Endoscopy and Negative Findings on Computed Tomography (CT) in the Sinuses Corresponding to the Drainage Pathways Visualized Endoscopically.

Concurrence of Neg Nasal endoscopy with Neg CT findings % (neg endo/neg CT)			
Nasal endoscopy	Maxillary, anterior ethmoid, and frontal	Posterior ethmoid	Sphenoid
Left	80.6 (29/36)	91.7 (33/36)	94.4 (34/36)
Right	83.3 (30/36)	91.7 (33/36)	97.2 (35/36)

Abbreviations: CT, computed tomography; Endo, endoscopy; Neg, negative.

predictive value of endoscopy in ruling out sinusitis as a cause of facial pain.[18] West and Jones showed that in 101 facial pain patients with negative endoscopy and CT scans, nearly all patients had non-sinogenic headaches.[13] The current study supports the value of negative nasal endoscopy, given that 90% of patients with craniofacial pain as chief complaints had negative endoscopies, and 80% to 97% concurrence rates were demonstrated between negative nasal endoscopy and CT findings. Taken together, nasal endoscopy could facilitate confirming or refuting whether craniofacial pain is sinogenic, regardless of imaging findings.

Another important point to discuss is unilateral facial pain, which could represent sinonasal, orbital, or intracranial pathology. Concerning sinonasal conditions like neoplasia or invasive fungal sinusitis most commonly occur unilaterally, but only represent about 2% to 14% of unilateral sinus disease, and are usually detectable on nasal endoscopy.[43-45] Other secondary headache disorders from orbital or intracranial neoplasia or vascular lesions should also be considered, but are very rare.[46-48] In the current study, about one-third of included patients had unilateral craniofacial pain, with the majority having migraine, and none having orbital or intracranial lesions. Notably, of the 2 patients with unilateral pain congruent to their sinusitis, 1 had a sphenoid sinus fungal ball but a negative preoperative nasal endoscopy. While definitive conclusions cannot be drawn from this study, sinus imaging may be beneficial in evaluating unilateral craniofacial pain to detect rare pathology that may be undetectable on endoscopy.

It is also important to acknowledge that some patients with craniofacial pain meet criteria necessitating neuroimaging, ideally MRI.[22] If nasal endoscopy is negative in patients with prominent craniofacial pain, and neuroimaging may be indicated, upfront sinus CT may not be necessary since sinus abnormalities would also be discovered on neuroimaging. It should also be noted that neuroimaging is indicated when patients have worsening pain, especially when unresponsive to therapy.[22] Therefore, in patients with prominent craniofacial pain but a negative nasal endoscopy, rare instances of causative sinus pathology would still be detected on neuroimaging in the event patients do not respond to medical therapy for headaches.

While determining the cause of facial pain can be challenging, some clinical features may increase suspicion of non-sinogenic headaches. First, given the high prevalence of migraine, clinicians can conduct a 3-question migraine screen: light sensitivity, nausea, or headaches/pain severe enough to prevent daily activities. Answering yes to 2 of the 3 questions yields 81% sensitivity and 93% positive predictive value in detecting migraine.[49] Additionally, consistent with prior studies showing high SNOT-22 and facial pain scores,[9,50] facial pain patients in the current study had high mean SNOT-22 (45.0) and facial pain scores (3.7). Furthermore, there were no differences between SNOT-22 and facial pain scores in patients with positive versus negative nasal endoscopies, consistent with non-sinogenic facial pain patients experiencing substantial detriments to sinonasal quality-of-life. These findings add support to prior literature that high scores on these questionnaires may facilitate screening for headache conditions in patients with prominent craniofacial pain.

There were also some notable discrepancies between the current study and prior publications. First, Lal et al reported that about 70% of their 211 patients presenting for sinus headache met diagnostic criteria for rhinosinusitis, which was substantially higher than the 5.2% prevalence shown in the current study. Additionally, they showed that about 30% of their patients had concurrent rhinosinusitis and primary headache disorders.[9] One difference between the 2 studies is that the current study used more stringent diagnostic criteria for headache being due to sinusitis, in that pain was required to be congruent to the side and sinus location of confirmed sinusitis. Lal et al did not report on sidedness or locations of sinusitis and pain, which could have led to a higher incidence of headache being attributed to sinusitis. Lal et al also had patients with more significant sinus disease burdens on CT, with 43% having sinus opacification, compared to 2% to 12% in the current study. The reasons for these different disease burdens on CT are unclear, but could be related to differences in regional disease states or proportions of self versus clinician-driven referrals. Self versus clinician referrals were not specifically recorded in the current study, but would be interesting to determine in future studies. One other discrepancy came from prior studies demonstrating sinus abnormalities in 30% to 80% of CT scans, while our study showed only about 15% to 30% of patients having sinus abnormalities on imaging like mucosal thickening or opacification (Table 3). The reasons for these discrepancies could best be assessed with a larger multicenter study with strict inclusion and exclusion criteria.

In summary, the current study demonstrated that the overwhelming majority of patients presenting primarily for craniofacial pain had headache disorders rather than sinus disease, and sinus CT correlated poorly with subjective pain locations. It should be reiterated that this study only included patients with facial pain as their chief complaint. Patients who had less severe facial pain compared to other associated sinusitis symptoms were not included, as these patients underwent a standard diagnostic and therapeutic approach for rhinosinusitis.[14] Findings from this study are not meant to discourage clinicians from ordering sinus imaging in patients with prominent craniofacial pain and negative nasal endoscopy, but to consider the utility of imaging in these scenarios. Clinical judgment is essential, and certain clinical features could arouse suspicion for underlying sinus pathology undetectable on endoscopy. Until more evidence accumulates, clinicians must weigh the benefits and limits of sinus imaging and nasal endoscopy when evaluating craniofacial pain.

There were also multiple study limitations. First, the sample size was relatively small from a single institution, limiting generalizability. Second, only patients with chief complaints of craniofacial pain were included, which limited the population of sinusitis patients with positive nasal endoscopies. Future studies should compare nasal endoscopy findings between all confirmed sinusitis patients (with or without craniofacial pain) and patients with most prominently craniofacial pain (with or without sinusitis), to determine the sensitivity and specificity of nasal endoscopy at predicting the likelihood of pain being non-sinogenic. Another limitation was that previously diagnosed primary headache or chronic pain disorders were not analyzed. It would be interesting in future studies to explore whether having previously diagnosed headache conditions changes the likelihood of craniofacial pain being due to sinusitis. Lastly, mucosal contact points, deviated nasal septum, concha bullosa, and allergic rhinitis were not studied as causes of facial pain, since evidence on these entities causing facial pain has been mixed. However, this could have confounded results, and future studies are necessary to understand their contributions to craniofacial pain.

Conclusion

Patients presenting with chief complaints of craniofacial pain generally met criteria for various non-sinogenic headache disorders, especially migraine and tension-type headache. Nasal endoscopy was negative in 90% of these patients, and CT findings demonstrated poor agreement with pain locations. Nasal endoscopy and CT shared high concurrence rates for negative sinus findings. The value of nasal endoscopy over sinus imaging in craniofacial pain evaluation should be explored in future studies.

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References

1. Witsell DL, Dolor RJ, Bolte JM, Stinnett SS. Exploring health-related quality of life in patients with diseases of the ear, nose, and throat: a multicenter observational study. *Otolaryngol Head Neck Surg*. 2001;125(4):288-298.
2. Mehle ME. What do we know about rhinogenic headache? The otolaryngologist's challenge. *Otolaryngol Clin North Am*. 2014;47(2):255-264.
3. Patel ZM, Setzen M, Poetker DM, DelGaudio JM. Evaluation and management of "sinus headache" in the otolaryngology practice. *Otolaryngol Clin North Am*. 2014;47(2):269-287.
4. Patel ZM, Kennedy DW, Setzen M, Poetker DM, DelGaudio JM. "Sinus headache": rhinogenic headache or migraine? An evidence-based guide to diagnosis and treatment. *Int Forum Allergy Rhinol*. 2013;3(3):221-230.
5. Levine HL, Setzen M, Cady RK, et al. An otolaryngology, neurology, allergy, and primary care consensus on diagnosis and treatment of sinus headache. *Otolaryngol Head Neck Surg*. 2006;134(3):516-523.
6. Lipton RB, Munjal S, Alam A, et al. Migraine in America symptoms and treatment (MAST) study: Baseline Study Methods, treatment patterns, and gender differences. *Headache*. 2018;58(9):1408-1426.
7. Eross E, Dodick D, Eross M. The sinus, Allergy and Migraine Study (SAMS). *Headache*. 2007;47(2):213-224.
8. Schreiber CP, Hutchinson S, Webster CJ, Ames M, Richardson MS, Powers C. Prevalence of migraine in patients with a history of self-reported or physician-diagnosed "sinus" headache. *Arch Intern Med*. 2004;164(16):1769-1772.
9. Lal D, Rounds A, Dodick DW. Comprehensive management of patients presenting to the otolaryngologist for sinus pressure, pain, or headache. *Laryngoscope*. 2015;125(2):303-310.
10. Perry BF, Login IS, Kountakis SE. Nonrhinologic headache in a tertiary rhinology practice. *Otolaryngol Head Neck Surg*. 2004;130(4):449-452.

11. Mehle ME, Kremer PS. Sinus CT scan findings in "sinus headache" migraineurs. *Headache*. 2008;48(1):67-71.
12. Foroughipour M, Sharifian SM, Shoeibi A, Ebdali Barabad N, Bakhshaee M. Causes of headache in patients with a primary diagnosis of sinus headache. *Eur Arch Otorhinolaryngol*. 2011;268(11):1593-1596.
13. West B, Jones NS. Endoscopy-negative, computed tomography-negative facial pain in a nasal clinic. *Laryngoscope*. 2001;111(4):581-586.
14. Rosenfeld RM, Piccirillo JF, Chandrasekhar SS, et al. Clinical practice guideline (update): adult sinusitis. *Otolaryngol Head Neck Surg*. 2015;152(2_suppl):S1-S39.
15. Headache Classification Committee of the International Headache Society (IHS) the International Classification of Headache Disorders, 3rd edition. *Cephalalgia*. 2018;38(1):1-211.
16. Leung R, Kern R, Jordan N, et al. Upfront computed tomography scanning is more cost-beneficial than empiric medical therapy in the initial management of chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2011;1(6):471-480.
17. Clifton NJ, Jones NS. Prevalence of facial pain in 108 consecutive patients with paranasal mucopurulent discharge at endoscopy. *J Laryngol Otol*. 2007;121(4):345-348.
18. Kieff DA, Busaba NY. Negative predictive value of normal nasal endoscopy for sinus disease as a cause of isolated facial pain. *J Laryngol Otol*. 2011;125(10):1038-1041.
19. Falco JJ, Thomas AJ, Quin X, et al. Lack of correlation between patient reported location and severity of facial pain and radiographic burden of disease in chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2016;6(11):1173-1181.
20. Al-Hashel JY, Ahmed SF, Alroughani R, Goadsby PJ. Migraine misdiagnosis as a sinusitis, a delay that can last for many years. *J Headache Pain*. 2013;14(1):97.
21. Klapper JA, Klapper A, Voss T. The misdiagnosis of cluster headache: a nonclinic, population-based, Internet survey. *Headache*. 2000;40(9):730-735.
22. Evans RW, Burch RC, Frishberg BM, et al. Neuroimaging for Migraine: the American Headache Society systematic review and evidence-based guideline. *Headache*. 2020;60(2):318-336.
23. Olesen J. From ICHD-3 beta to ICHD-3. *Cephalalgia*. 2016;36(5):401-402.
24. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33(1):159-174.
25. Barham HP, Zhang AS, Christensen JM, Sacks R, Harvey RJ. Acute radiology rarely confirms sinus disease in suspected recurrent acute rhinosinusitis. *Int Forum Allergy Rhinol*. 2017;7(7):726-733.
26. Daudia AT, Jones NS. Facial migraine in a rhinological setting. *Clin Otolaryngol Allied Sci*. 2002;27(6):521-525.
27. Lambru G, Elias LA, Yakkaphan P, Renton T. Migraine presenting as isolated facial pain: a prospective clinical analysis of 58 cases. *Cephalalgia*. 2020;40(11):1250-1254.
28. Schulz KA, Esmati E, Godley FA, et al. Patterns of migraine disease in otolaryngology: a CHEER Network Study. *Otolaryngol Head Neck Surg*. 2018;159(1):42-50.
29. Lai TH, Fuh JL, Wang SJ. Cranial autonomic symptoms in migraine: characteristics and comparison with cluster headache. *J Neurol Neurosurg Psychiatry*. 2009;80(10):1116-1119.
30. DeConde AS, Mace JC, Ashby S, Smith TL, Orlandi RR, Alt JA. Characterization of facial pain associated with chronic rhinosinusitis using validated pain evaluation instruments. *Int Forum Allergy Rhinol*. 2015;5(8):682-690.
31. Berg O, Carenfelt C. Analysis of symptoms and clinical signs in the maxillary sinus empyema. *Acta Otolaryngol*. 1988;105(3-4):343-349.
32. Fahy C, Jones NS. Nasal polyposis and facial pain. *Clin Otolaryngol Allied Sci*. 2001;26(6):510-513.
33. Eweiss AZ, Lund VJ, Barlow J, Rose G. Do patients with chronic rhinosinusitis with nasal polyps suffer with facial pain? *Rhinology*. 2013;51(3):231-235.
34. Orlandi RR, Kingdom TT, Hwang PH. International consensus statement on allergy and rhinology: Rhinosinusitis Executive Summary. *Int Forum Allergy Rhinol*. 2016;6(S1):S3-S21.
35. Hirsch SD, Reiter ER, DiNardo LJ, Wan W, Schuman TA. Elimination of pain improves specificity of clinical diagnostic criteria for adult chronic rhinosinusitis. *Laryngoscope*. 2017;127(5):1011-1016.
36. Havas TE, Motbey JA, Gullane PJ. Prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses. *Arch Otolaryngol Head Neck Surg*. 1988;114(8):856-859.
37. Kim SH, Oh JS, Jang YJ. Incidence and radiological findings of Incidental sinus opacifications in patients undergoing septoplasty or septorhinoplasty. *Ann Otol Rhinol Laryngol*. 2020;129(2):122-127.
38. Razi B, Perkovic A, Alvarado R, et al. Sinus radiological findings in general asymptomatic populations: A systematic review of Incidental mucosal changes. *Otolaryngol Head Neck Surg*. 2021;1945998211035097.
39. Nazri M, Bux SI, Tengku-Kamalden TF, Ng KH, Sun Z. Incidental detection of sinus mucosal abnormalities on CT and MRI imaging of the head. *Quant Imaging Med Surg*. 2013;3(2):82-88.
40. Shields G, Seikaly H, LeBoeuf M, et al. Correlation between facial pain or headache and computed tomography in rhinosinusitis in Canadian and U.S. Subjects. *Laryngoscope*. 2003;113(6):943-945.
41. Kim DH, Seo Y, Kim KM, Lee S, Hwang SH. Usefulness of nasal endoscopy for diagnosing patients with chronic rhinosinusitis: A meta-analysis. *Am J Rhinol Allergy*. 2020;34(2):306-314.
42. Goyal VK, Ahmad A, Turfe Z, Peterson EI, Craig JR. Predicting odontogenic sinusitis in unilateral sinus disease: a prospective, multivariate analysis. *Am J Rhinol Allergy*. 2021;35(2):164-171.
43. Turfe Z, Ahmad A, Peterson EI, Craig JR. Odontogenic sinusitis is a common cause of unilateral sinus disease with maxillary sinus opacification. *Int Forum Allergy Rhinol*. 2019;9(12):1515-1520.
44. Paz Silva M, Pinto JM, Corey JP, Mhoon EE, Baroody FM, Naclerio RM. Diagnostic algorithm for unilateral sinus disease: a 15-year retrospective review. *Int Forum Allergy Rhinol*. 2015;5(7):590-596.

45. Kaplan BA, Kountakis SE. Diagnosis and pathology of unilateral maxillary sinus opacification with or without evidence of contralateral disease. *Laryngoscope*. 2004;114(6):981-985.
46. Harooni H, Golnik KC, Geddie B, Eggenberger ER, Lee AG. Diagnostic yield for neuroimaging in patients with unilateral eye or facial pain. *Can J Ophthalmol*. 2005;40(6):759-763.
47. Prakash S, Rathore C, Makwana P, Dave A. A cross-sectional clinic-based study in patients with side-locked unilateral headache and facial pain. *Headache*. 2016;56(7):1183-1193.
48. Rogalewski A, Evers S. Symptomatic hemicrania continua after internal carotid artery dissection. *Headache*. 2005;45(2):167-169.
49. Lipton RB, Dodick D, Sadovsky R, et al. A self-administered screener for migraine in primary care: the ID Migraine validation study. *Neurology*. 2003;61(3):375-382.
50. Wu D, Gray ST, Holbrook EH, BuSaba NY, Bleier BS. SNOT-22 score patterns strongly negatively predict chronic rhinosinusitis in patients with headache. *Int Forum Allergy Rhinol*. 2019;9(1):9-15.