

# Staging for rhinosinusitis

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Interest in the surgical treatment of chronic rhinosinusitis has increased, primarily because rigid endoscopy and, more particularly, computed tomographic scanning have facilitated the visualization of disease. At the same time it has become both scientifically and financially imperative to audit therapeutic outcome. Consequently, a staging system for non-neoplastic sinus disease is needed. It is clear that any assessment of medical or surgical therapeutic response requires a method of quantifying disease severity that will be widely accepted by practitioners in the field. This acceptance will largely depend on how easy the method is to apply. With computed tomographic scanning it is possible to more accurately determine the extent of the pathologic condition in rhinosinusitis, a disease in which the severity of symptoms and the appearances on nasal endoscopy have a significantly more unpredictable correlation with the extent of disease. One goal of the Task Force on Rhinosinusitis of the American Academy of Otolaryngology–Head and Neck Surgery was to recommend a system for outcomes research that combines quantification with ease of application. (*Otolaryngol Head Neck Surg* 1997;117:S35-S40.)

## LITERATURE REVIEW

Although computed tomography (CT) findings have been used to develop a number of staging systems for rhinosinusitis, these approaches have proved too complex for use in routine clinical practice. Of the staging systems that have been proposed, some divide gross changes throughout the sinuses into four stages (stage 0 being normal) based on pattern of involvement (Tables 1 through 4),<sup>1-4</sup> and others use a numeric score for each sinus group (Tables 5 and 6).<sup>5,6</sup> One system is based on actual measurements of mucosal thickness (Table 7).<sup>7</sup> Yet another system uses five stages derived from an overall score based on the individual scores for site, surgery, polyps, infection, and immune status (Table 8).<sup>8</sup> This last approach is by far the most complex, and its scoring system is the most open to the dispute.

Several attempts have been made to compare interobserver and intraobserver agreement for a number of these systems. Gliklich and Metson<sup>4</sup> found that their

Harvard method was superior to the systems of Friedman et al.,<sup>1</sup> Kennedy,<sup>2</sup> and May et al.<sup>3</sup> After Friedman and Katsantonis<sup>9</sup> compared their system for predicting outcome with the systems of Kennedy<sup>2</sup> and Lund and Mackay,<sup>6</sup> they expressed their agreement with the overall view that radiographic assessment of the extent of disease is the major determinant for staging and prognosis. This had, in particular, been the conclusion of Kennedy,<sup>2</sup> who demonstrated that other potential prognostic factors such as allergy, asthma, and aspirin sensitivity were not significant when the radiographic extent of disease was taken into account in 120 patients with a mean follow-up of 18 months (range 3 to 51 months).

A more recent independent study by Oluwole et al.<sup>10</sup> compared the systems of Jorgensen,<sup>5</sup> May et al.<sup>3</sup> Lund and Mackay,<sup>6</sup> and Newman et al.<sup>7</sup> Of the four systems tested in patients with chronic rhinosinusitis, the Lund-Mackay system facilitated the highest level of both interobserver and intraobserver agreement.

## RECOMMENDATIONS

After reviewing the relative advantages and disadvantages of the various systems, the Task Force on Rhinosinusitis recommended the modified Lund-Mackay system for further outcome research and commissioned the authors to prepare this article.

The Lund-Mackay staging system, which is based on a simple numeric score derived from the CT scan, has been used for some years in the quantification of inflammatory disease before surgical intervention. The

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**Table 1.** Staging system proposed by Friedman and associates

Stage 0	Normal
Stage I	Single-focus disease (involving a single focus or single sinus unit)
Stage II	Multifocal disease (includes bilateral or multiple areas of disease that are not confluent or diffuse throughout the ethmoidal labyrinth, as well as bilateral middle meatal polyps)
Stage III	Diffuse disease (extensive bilateral involvement of multiple sinuses) without bony changes
Stage IV	Diffuse disease associated with bony changes

Adapted from Friedman WH, Katsantonis GP, Sivore M, et al. Computed tomography staging of the paranasal sinuses in chronic hyperplastic rhinosinusitis. *Laryngoscope* 1990;100:1161-5.

**Table 2.** Staging system proposed by Kennedy

Stage 0	Normal
Stage I	Anatomic abnormalities All unilateral sinus disease Bilateral disease limited to ethmoidal sinuses
Stage II	Bilateral ethmoidal disease with involvement of one dependent sinus
Stage III	Bilateral ethmoidal disease with involvement of two or more dependent sinuses on each side
Stage IV	Diffuse sinonasal polyposis

Adapted from Kennedy DW. Prognostic factors, outcomes and staging in ethmoid sinus surgery. *Laryngoscope* 1992;102(Suppl 57):1-18.

**Table 3.** Staging system proposed by Levine and May

Stage 0	Normal
Stage I	Disease limited to ostiomeatal complex
Stage II	Incomplete opacification of one or more major sinuses (frontal, maxillary, sphenoidal)
Stage III	Complete opacification of one or more major sinuses, but not all sinuses
Stage IV	Total opacification of all sinuses

Adapted from May M, Levine HL, Schaitkin B, et al. Results of surgery. In: Levine H, May M, editors. *Rhinology and sinusology*. New York: Thieme Medical Publishers, Inc., 1993:176-92.

**Table 4.** Staging system proposed by Gliklich and Metson (Harvard System)

Stage 0	Normal (< 2 cm mucosal thickening on any sinus wall)
Stage I	All unilateral disease or anatomic abnormality
Stage II	Bilateral disease limited to ethmoidal or maxillary sinuses
Stage III	Bilateral disease with involvement of at least one sphenoidal or frontal sinus
Stage IV	Pansinusitis

Adapted from Gliklich R, Metson R. A comparison of sinus computed tomography (CT) staging systems for outcomes research. *Am J Rhinol* 1994;8:291-7.

system received some minor modifications after the 1995 International Conference on Sinus Disease.<sup>11</sup>

### LUND-MACKAY STAGING SYSTEM

Demographic information is entered, with the nasal diagnosis classified numerically as follows: 1 = chronic rhinosinusitis, 2 = acute recurrent rhinosinusitis, 3 = nasal polyposis, and 4 = miscellaneous (Table 9). The miscellaneous group includes frontoethmoidal mucoceles, repair of cerebrospinal fluid leaks, orbital decompressions, dacryocystorhinostomy, and all other extended applications of endoscopic sinus surgery.

The systemic diagnosis might include asthma (with or without aspirin sensitivity), cystic fibrosis, primary abnormalities of mucociliary clearance (e.g., primary

ciliary dyskinesia, Young's syndrome), immune deficiency, bronchiectasis, sarcoidosis, and other conditions (e.g., diabetes mellitus, multiple myeloma) that might be relevant to the development of infection. Other potentially important information might include the patient's smoking history, allergy status, previous and present medications, and previous surgery.

The scoring system for the sinus groups is based on their appearance on the CT scan (Table 6). The CT scan is generally obtained after an adequate trial of medical treatment, although what constitutes an adequate trial may be the subject of some debate. Each sinus group is then assigned a numeric grade: 0 = no abnormality, 1 = partial opacification, and 2 = total opacification.

The sinus groups include the maxillary, frontal,

**Table 5.** Staging system proposed by Jorgensen

Structure	Left	Right
Frontal sinus opacification		
Maxillary antrum opacification		
Anterior ethmoidal labyrinth opacification		
Posterior ethmoidal labyrinth opacification		
Sphenoidal sinus opacification		
Maxillary antrum polyp		
Hiatus semilunaris occlusion		
Maxillary sinus ostium occlusion		
Frontal recess occlusion		
Ethmoidal infundibulum occlusion		

Scoring: For opacification: 0 = none, 1 = mild, 2 = moderate, 3 = marked, 4 = complete. For polyp size: 0 = none, 1 = small, 2 = medium, 3 = large. For occlusion: 0 = none, 1 = mild, 2 = moderate, 3 = complete.

Adapted from Jorgensen RA. Endoscopic and computed tomographic findings in ostiomeatal sinus disease. Arch Otolaryngol Head Neck Surg 1991;117:279-87.

**Table 6.** Radiologic grading of sinus systems proposed by Lund and Mackay

Sinus system	Left	Right
Maxillary		
Anterior ethmoidal		
Posterior ethmoidal		
Sphenoidal		
Frontal		
Ostiomeatal complex		
Total points for each side		

Scoring: For all sinus systems, except the ostiomeatal complex: 0 = no abnormalities, 1 = partial opacification, 2 = total opacification. For the ostiomeatal complex: 0 = not occluded, 2 = occluded.

Adapted from Lund VJ, Mackay IS. Staging in rhinosinusitis. Rhinology 1993;107:183-4.

**Table 7.** Staging system proposed by Newman and associates

Structure	Left	Right
Maxillary sinus		
Frontal sinus		
Sphenoidal sinus		
Ethmoidal sinus		
Ostiomeatal complex		
Nasal passages		

Scoring: For mucosal thickening in maxillary, frontal, and sphenoidal sinuses: 0 = none to 1 mm, 1 = 2 to 5 mm, 2 = 6 to 9 mm, 3 = >9 mm. For mucosal thickening in ethmoidal sinuses: 0 = none, 1 = 1 mm, 2 = 2 to 3 mm, 3 = >3 mm. For degree of obstruction: 0 = none, 1 = mild, 2 = partial, 3 = complete.

Adapted from Newman LF, Platts-Mills TAE, Phillips DC, et al. Chronic sinusitis: relationship of computed tomographic findings to allergy, asthma and eosinophilia. JAMA 1994;271:363-7.

sphenoidal, anterior ethmoidal, and posterior ethmoidal sinuses. Because it is difficult to apply this gradation to the ostiomeatal complex, the condition of this complex is simply scored as 0 (not obstructed) or 2 (obstructed). Thus a total score of 0 to 24 is possible, and each side can be considered separately (0 to 12).

Various anatomic variants that may be present include absent frontal sinuses, concha bullosa, paradoxical middle turbinates, Haller cells, an everted uncinate process, or agger nasi pneumatization (Table 10). These variants are noted as being present (1) or absent (0), but they do not contribute to the sinus score.

The Lund-Mackay staging system has been deliberately reduced to its simplest form to minimize individual variation in interpreting the degrees of opacification. No formal radiologic training is required to use this rhinosinusitis staging system, and independent assessment has demonstrated that it can be taught to junior staff in minutes.<sup>10</sup> The authors believe that the increased facility of application outweighs any potential difficulties engendered by combining all degrees of partial opacification into one category (especially in the maxillary sinus), although this aspect of the staging system may be revised in the future.

**Table 8.** Stages of surgical sinus disease proposed by Gaskins

Stage 0	Score: 0 (no surgical sinus disease)
Stage I	Score: <1.3
Site	Inflammation limited to the ostiomeatal complex area
Surgery	No previous sinus or nasal surgery except septoplasty and/or inferior meatal anastomies
Polyps	No polyps or polyps localized to <10% of the sinus space
Infection	Well-controlled infection with no active mucopurulent drainage
Immune status	No underlying immunologic disease except well-controlled allergy
Stage II	Score: 1.3 to 2.3
Site	Inflammation confined to the maxillary, ethmoidal, and ostiomeatal areas
Surgery	Previous Caldwell-Luc operation or polypectomy
Polyps	Polyp disease with involvement of 10% to 50% of the nasal and sinus cavities
Infection	Persistent localized infection with some active purulent drainage
Immune status	Low-grade immune disorder or fair allergy control
Stage III	Score: >2.3
Site	Pansinus involvement, unilateral or bilateral; isolated sphenoidal sinus disease
Surgery	Previous anterior ethmoidectomy and/or middle turbinate surgery
Polyps	Polyposis filling >50% of the nasal and sinus cavities
Infection	Poorly controlled multisinus infection with active mucopurulent drainage; active fungal sinusitis
Immune status	Poorly controlled allergic rhinitis or significant immune disorder; history of long-term steroid therapy
Stage IV	Any score: 4
Site	Sinus disease with extranasal and sinus extension; orbital or intracranial extension; frontal disease above the nasofrontal duct
Surgery	Previous complete ethmoidectomy and/or sphenoidectomy
Polyps	Inverting papilloma or other potentially malignant nasal or sinus neoplasm
Infection	Osteomyelitis or infection eroding into the orbit or cranium; mucormycosis
Immune status	End-stage immunologic disease/profoundly immunocompromised patient

Adapted from Gaskins RE. A surgical staging system for chronic sinusitis. *Am J Rhinol* 1992;6:5-12.

**Table 9.** Demographic information

Last name:	Operation:
First name:	Date of operation:
Sex:	Surgeon:
Date of birth:	Nasal diagnosis (0 to 4):
Age:	Systemic diagnosis:
Hospital number:	General or local anesthetic duration (minutes):
Postoperative medication:	
Complications:	

Two areas that require particular discussion are the absent frontal sinus and the effect of previous surgery on the appearance of the CT scan. A frontal sinus has been estimated to be absent in approximately 1% of a white population,<sup>12</sup> but it is actually rarer for there to be no demonstrable cavity on the coronal CT scan. Although the most accurate method of accommodating this situation would be to determine a percentage for the score out of 12 or 24 (or, in the case of an absent frontal sinus, 11 or 22-23), this would decrease the user-friendliness of the method. Thus it is suggested that an absent frontal sinus simply be scored as zero (0).

With regard to the effects of previous surgery on the CT scan, it is suggested that any mucosal thickening be regarded as relevant disease and scored as previously described. This mainly relates to the effects of a Caldwell-Luc operation on the maxillary sinus, a procedure that is being performed with decreasing frequency in both the United States and Europe.

Although the extent of disease is estimated based on the appearance of the CT scan, it may be of interest to quantify other aspects of the disease and its treatment. Thus a surgery score may be derived (Table 11), with the scoring based on whether any one of the seven listed procedures was performed (1) or not performed (0). The total score can range from 0 to 14, or 0 to 7 for each side. This system allows a quantification of the operation that may, if desired, be correlated with other parameters.

Symptoms are assessed by the patient on a visual analog scale of 0 to 10, where 0 indicates that no symptom is present and 10 signifies the presence of the most severe nasal obstruction or congestion, headache, facial pain, alteration in the sense of smell, nasal discharge, and sneezing. An overall assessment of symptom severity is also included. Although this is a well-established method for evaluating patients with rhinologic conditions,<sup>13</sup> it is also of interest to ask the patient to prioritize his or her three worst symptoms. In this way it is possible to distinguish the relative importance of symptoms that have been given the same score, and the result does not always equate with the visual analog scale. The symptom score is evaluated before surgery and at regular intervals after surgery (Table 12).

The endoscopic appearances of the nose are also quantified for the presence of polyps (0 = none, 1 = confined to middle meatus, 2 = beyond middle meatus), discharge (0 = none, 1 = clear and thin, 2 = thick and purulent), and edema, scarring or adhesions, and crust-

**Table 10.** Radiologic grading: Anatomic variants

Anatomic variant	Left	Right
Absent frontal sinus		
Concha bullosa		
Paradoxical middle turbinate		
Everted uncinate process		
Haller cells		
Agger nasi cells		
Total points for each side		

Scoring for all anatomic variants: 0 = no variant, 1 = variant present.

**Table 11.** Surgery score

Surgical procedure	Left	Right
Uncinectomy		
Middle meatal antrostomy		
Anterior ethmoidectomy		
Posterior ethmoidectomy		
Sphenoidectomy		
Frontal recess surgery		
Reduction of middle turbinate		
Total points for each side		

Scoring: 0 = no procedure done, 1 = surgery done. The total score can range from 0 to 14 (0 to 7 for each side).

**Table 12.** Symptom score

Symptom	Before surgery	After surgery			
		3 months	6 months	1 year	2 years
Nasal blockage or congestion					
Headache					
Facial pain					
Alteration in the sense of smell					
Nasal discharge					
Sneezing					
Overall symptom					
Total points					

Scoring: The patient assesses each symptom on a scale of 0 to 10 (visual analog scale), with 0 indicating that the symptom is not present and 10 signifying that the symptom is extremely severe.

**Table 13.** Endoscopic appearances

Characteristic	Baseline	3 months	6 months	1 year	2 years
Polyp, left					
Polyp, right					
Edema, left					
Edema, right					
Discharge, left					
Discharge, right					
Scarring, left*					
Scarring, right*					
Crusting, left*					
Crusting, right*					
Total points					

Scoring: For polyps: 0 = absence of polyps, 1 = polyps in middle meatus only, 2 = polyps beyond middle meatus. For edema, scarring, and crusting: 0 = absent, 1 = mild, 2 = severe. For discharge: 0 = no discharge, 1 = clear, thin discharge, 2 = thick, purulent discharge.

\*Postoperative scores to be used for outcome assessment only.

ing (for each: 0 = absent, 1 = mild, 2 = severe). These appearances are assessed before surgery and at regular postoperative visits, but they are not included in the staging system. Like the symptom score, the endoscopic appearances are recorded on a relational database (Table 13).

## DISCUSSION

A staging method that relies on CT appearances to define the extent of disease is by no means perfect because of the problems of interpretation posed by previous surgery, the occasional natural absence of the

frontal sinus, and the difficulty in differentiating between opacification resulting from inspissated mucus and mucosal inflammation, which may have prognostic significance. It is also well known that the correlation between symptoms and the extent of disease is generally poor. Notwithstanding these criticisms, CT scanning does offer one of the few assessments of rhinosinusitis that can be objectively quantified and that can be applied to the vast majority of patients in routine clinical practice.

Simplicity is the key to general usefulness. The Lund-Mackay staging system is a simple method that is

easy to apply and reproduce. Furthermore it seems highly suited to the validation of outcomes in large clinical studies.

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