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### TNM Visual Manual

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# ROCHESTER INSTITUTE OF TECHNOLOGY

A Thesis Submitted to the Faculty of  
The College of Imaging Arts and Sciences  
In Candidacy for the Degree of  
MASTER OF FINE ARTS

## TNM Visual Manual

by

Tiffany Gagnon

May 21, 2005

# Approvals

Chief Advisor: Glen Hintz

Signature: Glen Hintz

Date: \_\_\_\_\_

Associate Advisor: Jim Perkins

Signature: Jim Perkins

Date: \_\_\_\_\_

Associate Advisor: Jim Ver Hague

Signature: Jim Ver Hague

Date: \_\_\_\_\_

Department Chairperson: Don Arday

Signature: Don Arday

Date: \_\_\_\_\_

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## I. Introduction

As cancer becomes an increasing concern in today's society, it is important to better understand the spread patterns that different cancers tend to exhibit. When physicians understand and can begin to predict where a particular cancer will spread, they are better able to diagnose and treat their patients. In order for physicians to be able to do this, they need competent manuals and diagrams to help them accurately recognize and stage these cancers.

To date, the staging manuals that exist are mostly textual, with few or no diagrams illustrating the complex concepts surrounding cancer staging. Visual aids are critically important in helping physicians stage cancers; having few and poor illustrations makes the process of staging cancers more difficult, as the process and the system can vary widely between cancer forms.

Cancer spread patterns are predicted using a complex system of letters and numbers that can be useful only if it is clearly understood and is applicable to clinical cases. Known as the TNM (Tumor, Node, Metastasis) System,

the current method of staging cancers utilizes the three main events that occur in the "life" of a cancer: 1. Local tumor growth (T), 2. Regional lymph node involvement (N), and 3. Distant metastases (M).

The purpose of this thesis is to help make the TNM system more useful for physicians in their everyday work with cancer staging, diagnosis and treatment. In order to do so, I have created a series of illustrations that improve upon existing visual aids by using color and other important organizational factors to depict the spread patterns of cancer as well as diagrammatic representations of the TNM staging system. In addition to physical organization of the TNM system, I have created a color-coding system to further organize the information. It is my hope that these diagrams, in conjunction with the text in the manual, will help physicians to easily and accurately diagnose and treat their cancer patients.

My illustrations are predominantly vector-based art created using Adobe Illustrator™. My main focus in creating these illustrations was to use graphics, clear information organization and purposeful use of color to make the TNM system more useful for physicians. Many of the staging diagrams I created

use original artwork from *The Grant's Atlas of Anatomy* as the publisher with whom I worked owns the copyright to these images and has the authority to use them in other manuals apart from the original atlas.

Ultimately, the illustrations I have created will be compiled into a visual manual that will be used as quick reference material for physicians to use when diagnosing patients. I was approached by the author of this manual to do the artwork and I accepted the assignment eagerly, hoping that it would turn out to be a great experience for me working in a freelance setting as well as provide me with a thesis topic that is engaging and beneficial to the medical field.

For this paper I will be discussing the illustrations, diagrams and TNM staging system for the Head and Neck only. There are so many different forms of cancer that are found in almost every organ in the body that to talk about each and every one of them would be too much. I have chosen the Head and Neck for two reasons. First, I am most interested in those cancers as my father was recently diagnosed with having cancer of the tongue. Second, the Head and Neck cancers have been heavily researched and documented and so the information is rich in quality and

quantity. This richness in quality results from the importance of this region to the rest of the body. Not only is one of our most vital organs, the brain, located in the head, but the majority of our sensory organs are located within the head and neck region as well. The loss of the use of any of these vital organs can seriously inhibit a person's way of life. In addition to this, "malignant disease of one part of this complex functional unit may indirectly have far-reaching influence on other regions (Rubin, 1993, 319)."

## II. Research

In order to collect research materials for this thesis I wanted to look at and analyze the visuals contained in existing cancer staging manuals. The RIT library's collection of these kinds of references was limited. However, I was able to get most of my materials through inter-library loan from larger medical libraries. Some of the manuals I found include *Handbook of Cancer Diagnosis and Staging: A Clinical Atlas*, published by Springer in 1984 and *TNM Atlas: Illustrated Guide to the TNM/pTNM Classification of Malignant Tumors*, published by John Wiley & Sons in

1997. One big problem I encountered was that most of the manuals I found were very outdated, some dating as far back as 1984, the most recent dating to 2002. The field of cancer research, and subsequently staging and diagnosis, is an ever-changing one in which information can quickly become outdated. The fact that some of my references are as many as 20 years old I found to be actually beneficial to my research. I was able to compare and contrast how the methods of staging and visualizing cancer patterns have evolved over the past few decades. While the organization of the TNM system has not changed dramatically, the amount and quality of the collected data has grown extensively. Newer TNM staging diagrams are expanding and changing to include this updated information. By discovering and evaluating this occurrence, I was able to evaluate the trends and direction in which the field is moving in order to better suit my illustrations to be useful in the future.

Once I had gathered my resources I began to analyze the strengths and weaknesses of the visual aids within each manual. By gathering critical information, like color usage, size, shape, organization and accuracy of anatomical information I was able to create my

work to improve upon any weaknesses that I had gathered from my research.

### **History of the TNM System**

The TNM System was developed between the late 1940's and early 1950's (Sobin, 2002, 1) to fill a need for a standardized system of cancer staging that could be used universally among physicians. Previous to this system, physicians were using several different forms of staging to document their findings and were often running into inconsistencies in their records. The International Union Against Cancer (UICC) was the first to recognize the inconsistencies and decided that it was necessary to create one uniform system that would be used worldwide. "The UICC recognizes the need for stability in the TNM classification so that data can be accumulated in an orderly way over reasonable periods of time (Sobin, 2002, 4)." As physicians began to understand more about cancers and their consequences it became evident just how important this TNM system could be to cancer management. Through evaluation of research it was concluded that survival rates were often higher in individuals whose cancer was found in an early stage, a so-called 'early



case.’ “The survival time is correlated with the stage of the tumor at the time of diagnosis (Noltenius, 1988, 474).”

It became apparent that precisely determining and describing the stage of a cancer upon detection could directly relate to the patient’s survival. The precise clinical description of a malignant tumor served several purposes:

- To aid the clinician in planning treatment
- To give some indication of prognosis
- To assist in evaluation of the results of treatment
- To facilitate the exchange of information between treatment centers
- To contribute to the continuing investigation of human cancer.

(Sobin, 2002, 5)

The TNM system has been widely used since its introduction in the late 1940’s as the primary method for staging and documenting cancers. Over this period of time it has proven to be a very useful method for documenting cancer patterns.

### What Is The TNM System?

“In effect the system is a ‘shorthand notation’ for describing the extent of a particular malignant tumor (Sobin, 2002, 6).” This com-

plex system of letters and numbers is actually easy to use if you understand the basic rules of how it is organized. First, the system is based on the evaluation of three main factors;

**T** – The extent of the primary **T**umor; size, shape and integration into its surrounding tissues

**N** – The extent of regional lymph **N**ode involvement

**M** – Distant **M**etastasis; Any other locations within the body apart from the original site to which the cancer has or has not spread

Once these factors have been assessed, they must be narrowed down by assigning numbers based on varying levels of the extent of that category whether it be T, N or M. These numbers/levels are generally assigned as follows:

**X** - The extent cannot be assessed

**0** - No evidence of involvement

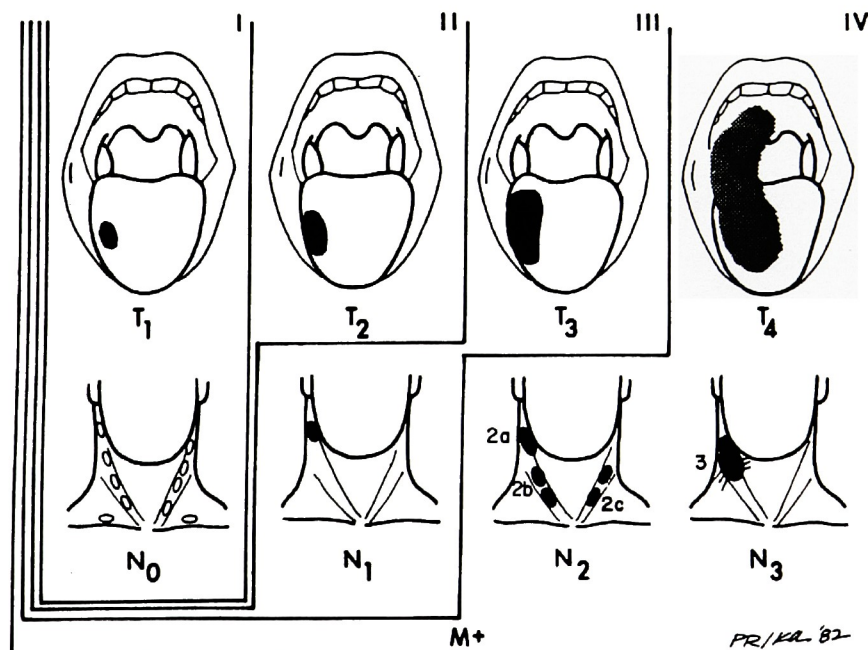
**is** - Meaning “in situ,” this level applies to the *tumor* only and is used when the tumor can be identified in its primary location but can not be measured (may be assessed histologically in some cases)

**1 through 4** – Increasing size, location or integration of each factor into its surrounding tissues

Once numbers or levels have been assigned to each factor, they can be organized into stages. In general there are approximately six stages, 0 through IV (sometimes IVA and IVB.) The way that stages are determined varies between different cancer types but generally they are determined based on the primary tumor assessment and the involvement of regional lymph nodes. The highest stage, usually IV, A or B, is assigned when a distant metastasis is found.

In this diagram of cancer of the Oral Cavity (See Figure 1.) you can see how the

stages increase as the tumor size and lymph node involvement increase. Stage I has no lymph node involvement, Stage II has a larger local tumor and no nodal involvement and Stages III and IV have yet larger tumors and more nodal involvement with distant metastasis becoming involved in Stage IV. In fact, if metastasis is identified, then Stage IV is declared regardless of tumor size or node involvement. This pattern of organization and delineation of stages is similar for all cancers with minor differences occurring. In general, the head and neck sites are organized into stages identically with the only differences being the location of the primary tumor, specific nodal involvement and locations for distant metastases.



**Figure 1.**

## **How is the TNM System Used?**

The TNM system is used in a clinical setting to help physicians determine the extent of a cancer, determine a course of treatment and to give a general prognosis for the patient.

The shorthand notation of the system allows information to be exchanged easily and accurately between physicians, assuring that all parties involved with a specific case or patient are consistent in their understanding of the extent of the cancer and the different treatment options and prognosis methods that are available.

In addition, the TNM system is useful for cancer research purposes. Not only does it allow researchers to have an easy and consistent way to maintain accurate records, it also allows for quick comparison of cancers. This can be important when evaluating individual cases, allowing a physician to use previous cases to predict where a patient's cancer may spread and also how it may be more effectively treated. By drawing patterns and similarities between different cases of the same cancer or even between different types of cancers, researchers are able to learn more about the mechanisms of cancer, potentially leading to a cure.

## **Why is the TNM System Important?**

As mentioned earlier, when a cancer can be diagnosed and treated earlier in its lifetime, the prognosis for a patient is generally better. When physicians use the TNM system they can be assured that they are accurately assessing the cancer's extent and are prescribing the right kind of treatment, ultimately leading to a better chance of survival for the patient. Also as previously discussed, the fact that the TNM system standardizes the methods of cancer data collection is critical, because it allows physicians to easily obtain accurate and organized information about the history of any cancer at any time.

## **Evolution of the TNM System**

As oncology research methods and knowledge of the mechanics of cancer have been evolving over the past few decades, so has the TNM system. As oncologists add more and more information to their records, the TNM system has had to expand and evolve to encompass this larger breadth of information. As the complexity of the information and of the system itself increases so does the necessity for it to be useable and accessible for



physicians. The system can be very useful in a clinical setting only if the resources are easily understood.

As the TNM system is evolving over time, the manuals that physicians are using are incorporating more visual components. Diagrams and illustrations make the information clearer and easier to find amongst pages of detailed textual information. This is especially important in a clinical setting where a physician may need to find certain pieces of information quickly. If he can flip through a manual and look at one diagram and get everything he needs without having to read an entire chapter's worth of text, he has saved himself and potentially his patient a lot of time and money.

Because the role of these visuals is so important, it is crucial that they are clear, well organized and easy to use. In my research I found that most of the diagrams did not meet these criteria.

### **Critique of Existing Visuals**

In general the quality of the visuals I found was very poor. They were all black and white, relatively small, sometimes "fuzzy" in appearance and often lacking in anatomi-

cal detail. Also, because the manuals that I found were published anywhere from a few to twenty years apart from one another, I found that there were many inconsistencies between them. This is due to the fact that our knowledge of cancer has changed so much over the years that each successive publication includes a more detailed understanding of the subject. This particular problem is unavoidable in this field, but can be lessened by using visuals that cover more detail and account for a larger amount of information.

This brings me to my work and how I have been able to improve upon the areas in which the older visuals are lacking. My illustrations are in color, are larger, and are more detailed in the information and anatomy that they contain. I have also tried to standardize the look and feel of the artwork to facilitate comparisons of different cancers.

In the next few pages I will discuss the specific decisions I had to make and the process I used to achieve a more successful set of visualizations for the TNM system.

### III. Process

#### History

The project was presented to me as a need for an illustrator to compile a series of diagrams and figures to be included in a manual which would be used by physicians in a clinical setting to aid in the staging of cancers. To begin, the author of this project was compiling a comprehensive visual atlas that would be a companion to a previously published manual on staging cancers titled *Clinical Oncology: A Multidisciplinary Approach for Physicians and Students*. This existing manual includes simple, black and white diagrams that are not entirely useful in a clinical setting in which they would be used. The author wished to create a full color atlas to illustrate the content of the existing manual as well as to serve as a quick reference manual for physicians to use in a clinical setting.

#### Creation

In creating the artwork for this manual there were many factors that had to be taken into account. Organization of the information, size of the illustrations, orientation and color

were a few of the most important considerations. In addition, the actual negotiation with the author of the manual played a big role in the development of the work. The technical issues involved with the creation of the work were just as important to the final outcome of the body of work. These technical issues will be discussed further in the following pages.

I began by analyzing the illustrations in the original manual, looking at their effectiveness in presenting the information as well as their usefulness to the readers of the manual. Many of the original illustrations were formatted horizontally on the page, often occupying only one quarter or less of the page, causing them to be very small and often unclear. I decided that the new artwork would be formatted vertically to fill an entire page in the final manual while still allowing more room for text. The author of the book supported this decision as he envisioned these diagrams being the key content of the final manual.

I also concluded that the black and white original illustrations were unclear and lacked the necessary information content. I decided that full color includes a lot more information more clearly. Again, this decision was encouraged and originally suggested by the author as a way to make the manual more successful



in achieving its goals. Also, with the addition of color came the ability to create a color-coding system that I found would aid in the quick-reference-manual nature that the author desired. This will be discussed further in following paragraphs.

### **The Grant's Images**

Another very important decision I made was to use traditional color artwork from *The Grant's Atlas of Anatomy* to provide the anatomical information in the diagrams. In contrast to these hand drawn illustrations, the layout and organization of the actual information; gridlines, arrows, tumors and text would be inserted using Adobe Illustrator™. By using these original traditional illustrations we achieved two key goals: to save time by not creating all new anatomical illustrations; and to create a clear contrast between the anatomy and the critical information. I was allowed to use the Grant's images only because the publisher, Lippincott, Williams & Wilkins, owns the copyright to all of that artwork and approved the use of it for this manual.

There were many reasons why the author and I decided to use the Grant's images instead of creating completely new anatomy

for all of the illustrations. The most important reasons were the time and monetary constraints. The author was on a tight deadline to have the artwork completed for the publisher. Given the number of illustrations needed, I was sure that we could not meet that deadline if I were to create all new artwork for the manual. Second, the author simply did not have the budget to pay for me to create all of the anatomical artwork 'from scratch.'

We also agreed that not only would the use of the Grant's images save us time and money, but by using this atlas of work we could be confident that our illustrations would be anatomically accurate and clear.

After working with the Grant's images for a few weeks I discovered that another benefit of using them instead of original artwork was that they provided us with an immediate visual difference between the hand-drawn anatomic information and the vector-based representations of the tumors, arrows and other graphics that I was adding. As a result, the illustrations are actually clearer and more useful as quick reference materials because the organizational information can be clearly distinguished from the anatomical information.

Using the images from the Grant's Atlas

presented the problem of deciding how to get the illustrations from the original atlas into Adobe Illustrator™ to place inside of my grids and figures. I used the following several steps:

### **1. Request high-resolution files from publisher**

I looked through the printed atlas, found the anatomy that I needed and chose a few of the most useful illustrations. I then contacted the publisher and told them which illustrations I needed, usually by giving them specific figure and page numbers for each illustration.

### **2. Pull art from publisher's page layout files**

The artwork usually arrived on CDs from the publisher still encased in their page layouts, in EPS format, with labels and leader lines from the atlas. I opened each page layout file in Adobe Illustrator™ to retrieve the illustration I needed.

### **3. Copy and paste artwork from publisher's files to my files**

Once I found the illustration I needed, I copied and pasted the artwork from the publisher's file into my own Adobe Illustrator™ file. This method created one big problem. It led to large file sizes because the illustrations I was pasting were high-resolution files for printing and were often duplicated five or six times within one diagram. I decided to do this, however, because I knew that the files would be changing hands several times, from myself to the author for detailed changes concerning content and then on to the publisher. If I had linked the files rather than pasting them directly into the layouts the placed artwork could have been lost or misplaced. Before creating the artwork, I contacted the publisher to make sure that they could accept such large files. They assured me that this was fine and agreed that it would be the best way to assure that artwork did not get lost between 'hand-changes.'

### **4. Resize, crop and place artwork into diagrams**

After pasting the illustrations into my own Adobe Illustrator™ files, they needed to be resized, masked and placed into my diagrams and illustrations. This step was generally

simple. However, I needed to be careful how I changed the size of the illustrations. I was careful not to scale any of them up as their resolution would degrade proportionally. The majority of the time I only needed to reduce them, thereby avoiding any image degradation.

## **5. Make adjustments to content of illustration if necessary**

Occasionally the original artwork contained something that was unnecessary and potentially distracting to my final artwork. In one instance, the original illustration contained a large black arrow that interfered with the arrows I was creating myself. I opened that particular illustration in Adobe Photoshop™ and was able to eliminate that arrow and replace the anatomy in its place. In another situation, the Grant's illustration was missing a specific vein that was necessary to the illustration I was working on. Again I opened that illustration in Adobe Photoshop™ and added the necessary vein. In general the illustrations were adequate and needed few touch ups.

One problem I encountered using the Grant's images was that the publisher was

often slow to get the high-resolution files to me. Because we were working under a time constraint, I often found myself without the high-resolution files that I needed to create a particular diagram. In this situation I had to find an alternate method of inputting the artwork until the high-resolution file was available. The Grant's Atlas I was working with came with a CD ROM with thumbnail images of many of the illustrations from the book. I often used these thumbnails as placeholders for the images so that I could complete the diagrams and then later replace them with the high-resolution images. If a thumbnail was unavailable I scanned the illustration directly from the book and worked off of the scan.

Also, I ran into this situation if the author decided to use a different Grant's illustration. I then needed to request it additionally from the publisher and wait for it to reach me while still trying to complete the artwork. This was difficult because it often took more time to replace the high-resolution file than it would have taken if I had had it from the beginning. At the time however, this was the only way to move forward with the work on the illustrations.



## Orientation and Size

One of the first major decisions in the creation of the work was the orientation of the staging grids. As mentioned previously, a vertical format seemed to be the best solution

to fit the illustrations on the page. Because we wanted the manual to be comprised almost entirely of artwork, it was important that the diagrams fill the page and be the center of attention in each page layout. The vertical format allowed us to insert text and other

information in columns on either side of the illustrations.

This text would relate directly to the visual content of the adjacent illustration. (See

Figure 2). In this example, the text in the left and right hand columns includes technical information (size and exact location of the tumor, for example) about the box to which it is adjacent. By doing

this, we added to the ability of the manual to serve as a quick-reference for physicians. In a clinical setting, a physician can open to a page with a large diagram in the center and find any pertinent information located conveniently immediately adjacent to the image.








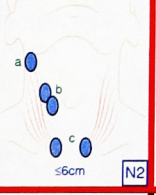


| DEFINITION OF TNM |  | T1S   | N0  | STAGE GROUPINGS   |  |
|-------------------|--|---|---|---|--|
| 0                 | <b>T1</b><br>Tumor restricted to any one subsite, with or without bony invasion  |    |    | <b>Stage I</b><br>T1 N0 M0  |  |
|                   | <b>N0</b><br>No regional lymph node metastasis   |   |   |   |  |
| I                 | <b>T2</b><br>Tumor invading two subsites in a single region or extending to involve an adjacent region within the nasopharyngeal complex, with or without bony invasion                        |    |    | <b>Stage II</b><br>T2 N0 M0   |  |
|                   | <b>N0</b><br>No regional lymph node metastasis   |   |   |   |  |
| II                | <b>T3</b><br>Tumor extends to invade the medial wall or floor of the orbit, maxillary sinus, palate, or cribriform plate   |   |   | <b>Stage III</b><br>T3 N0 M0<br>T1 N1 M0<br>T2 N1 M0<br>T3 N1 M0                            |  |
|                   | <b>N1</b><br>Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension   |   |   |   |  |
| III               | <b>T4a</b><br>Tumor invades any of the following: anterior orbital contents, skin of nose or cheek, minimal extension to anterior cranial fossa, pterygoid plates, sphenoid or frontal sinuses |  |  | <b>Stage IVA</b><br>T4a N0 M0<br>T4a N1 M0<br>T1 N2 M0<br>T2 N2 M0<br>T3 N2 M0<br>T4a N2 M0 |  |
|                   | <b>N2</b> Metastasis in lymph nodes, none > 6 cm<br>(N2a) Single ipsilateral, >3 cm but ≤6 cm<br>(N2b) Multiple ipsilateral, none >6 cm<br>(N2c) Bilateral or contralateral, none 6 cm         |   |   |   |  |
| IVA               | <b>T4b</b><br>Tumor invades any of the following: orbital apex, dura, brain, middle cranial fossa, cranial nerves other than (V2), nasopharynx, or clivus                                      |  |  | <b>Stage IVB</b><br>T4b Any N M0<br>Any T N3 M0   |  |
|                   | <b>N3</b><br>Metastasis in a lymph node, more than 6 cm in greatest dimension  |   |   |   |  |
| IVB               |  |   |   |   |  |
| IVC               |  |   |   |   |  |

Figure 2-2. TNM stage grouping. Vertical presentations of stage groupings which follow same color code for cancer stage advancement are organized in horizontal lanes: Stage 0 yellow, I green, II blue, III purple, IVA red and IVB black. T and N definitions of progression are on the left and stage groupings are on the right.

Figure 2.

The size of the illustrations was determined by specifications I received from the publisher. Illustrations that would spread the entire width of the page were to be 42 picas wide and illustrations that would only fill one column would be 20 picas wide. All of my illustrations were designed to fit in one column so they all conform to the 20 pica standard, with the height being restricted only by the height of the page. The book will be published with page sizes being roughly 8.5 by 11 inches. Leaving room for headers, text and page numbers my illustrations did not exceed a height of about 50 picas.

The size and orientation of the artwork directly relates to the final size and consequently, the cost of the actual book. One of the manuals I found in my research used six full pages to illustrate what I was able to

illustrate in one diagram. Also, because of the orientation of my diagrams and the availability of space alongside them for text, we conserved space within the manual, thus reducing its cost.

## Organization of the Grids

Another important decision in the process of creating the illustrations was how to orient the lines delineating the different stages. In previous manuals, these lines often turned at 90-degree angles many times. In addition, the lines all gathered at one end of the page and ran parallel to one another, taking up valuable space in an attempt to demonstrate the overlap that can occur between stages. (See Figure 3A) In our illustrations, we eliminated all bends in the lines as well as eliminated

this parallel running of the lines along the edge of the illustration. The resulting illustration is more clean, organized and ultimately more effective in communicating its information. (See Figure 3B) Also, with our lines running straight across the diagram as opposed to bending, we are able to carry them completely across the page to help organize the corresponding text. (See

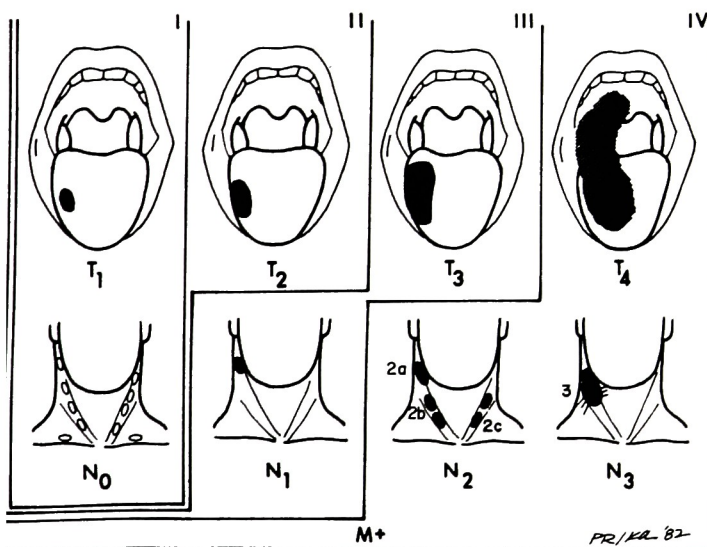


Figure 3A.



Figure 2) We chose to use this text, which is placed in the right hand column, as a means to explain the overlap between stages.

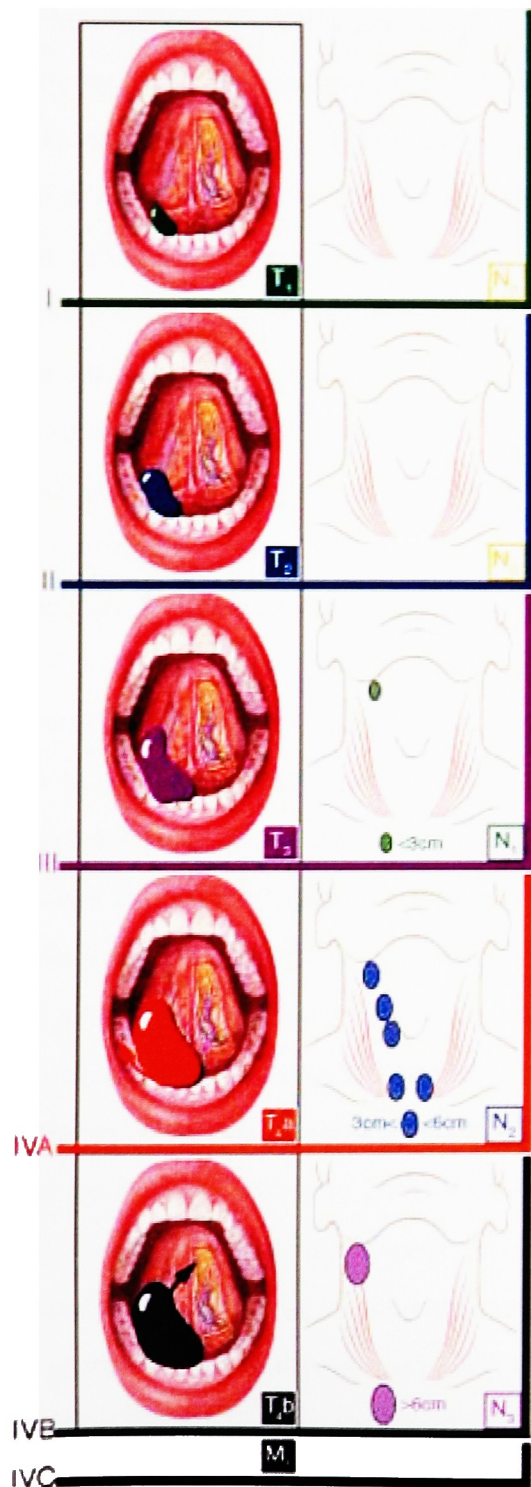


Figure 3B.

## Color

Another major decision I made was to use full color in my illustrations. After studying the older black and white manuals, I was certain that color was necessary for clarity. (See Figure 4) In this example, taken from one of the manuals I found during my research, the illustration is inadequate in many ways. Perhaps one of the most obvious problems is the use of shades of gray to illustrate the different tumor sizes. The lightest shade used is too light and tends to disappear while the darker shades are too close to one another and start to blend together.

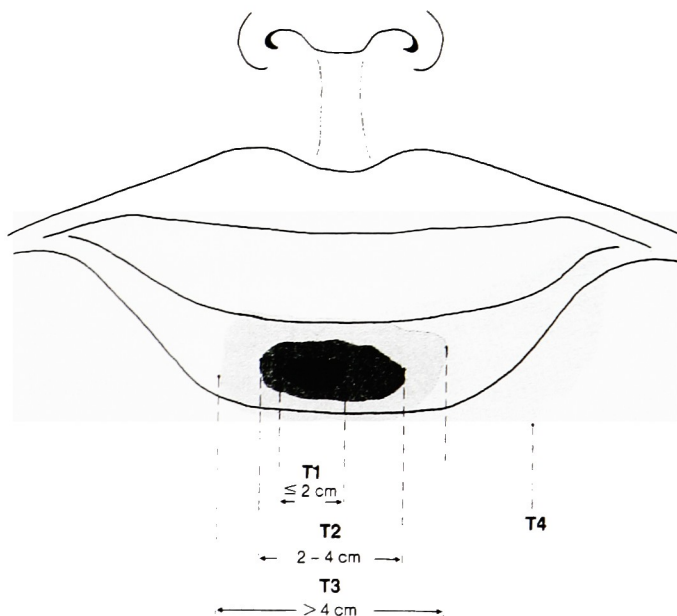


Figure 4.

Another big problem I see with this illustration is the individual labels and dotted lines used to delineate the size of the tumors. The lines are confusing while the labels are inconsistent in spacing and length. The anatomy, while recognizable, is poorly drawn and almost unnecessary. This illustration uses half of an entire page in its original publication. In the same amount of space I am able to provide the same information regarding tumor size but have also included the additional tumor involvement and stage delineations while using color, anatomical art and graphical information in a visually stimulating way. (See Figure 3B for content comparison.)

Once I decided to use full color in my illustrations, I developed a color code that was linked to the different stages of cancer. In general there are six stages including 0 through IVA or B. I assigned a different color to each stage that would be used anytime that particular stage was being referred to in an illustration. I chose these specific colors on a purely aesthetic scale. I found that the progression from yellow to green to blue to purple seemed appropriate because this is the order in which these colors are found in the spectrum. Inherently, red and black draw attention and are usually associated with dark-

ness, fear or danger. I chose to use these two colors to represent the higher stages to reinforce the idea that the highest stages are the most critical or serious stages.

Stage 0 – yellow

Stage I – green

Stage II – blue

Stage III – purple

Stage IVA – red

Stage IVB – black

In Figure 5, Stage II has been assigned the color blue in the diagram on the left. Then in the patterns of spread illustration on the right, blue has been used again, this time to illustrate that in Stage II the cancer will most likely spread to the nasal cavity. This color-coding system has been used in every figure within the manual that illustrates the different stages of each cancer. By incorporating this color-coding system we have made it easy for physicians to determine the current stage of a cancer and where it can be expected to spread. This system is also useful when comparing two cancers to one another as the color-coding system makes it easy to draw quick comparisons.



The use of color has not only allowed my illustrations to be more visually stimulating but has also allowed the lines in the staging diagrams to be more easily distinguished, the anatomy to be more detailed and the quick reference aspect of the illustrations to be more effective.

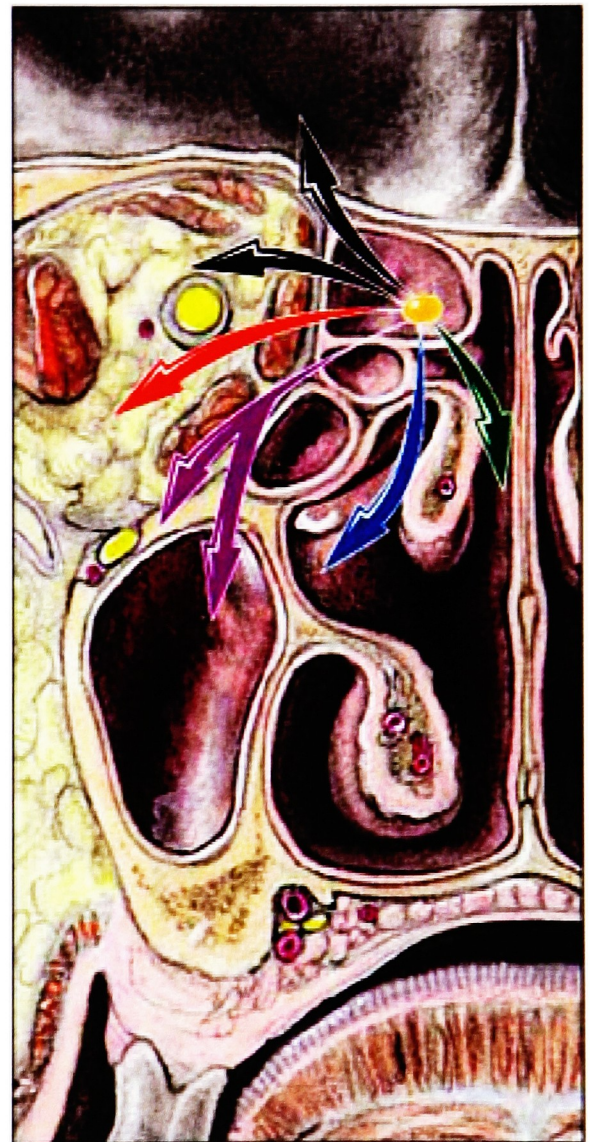
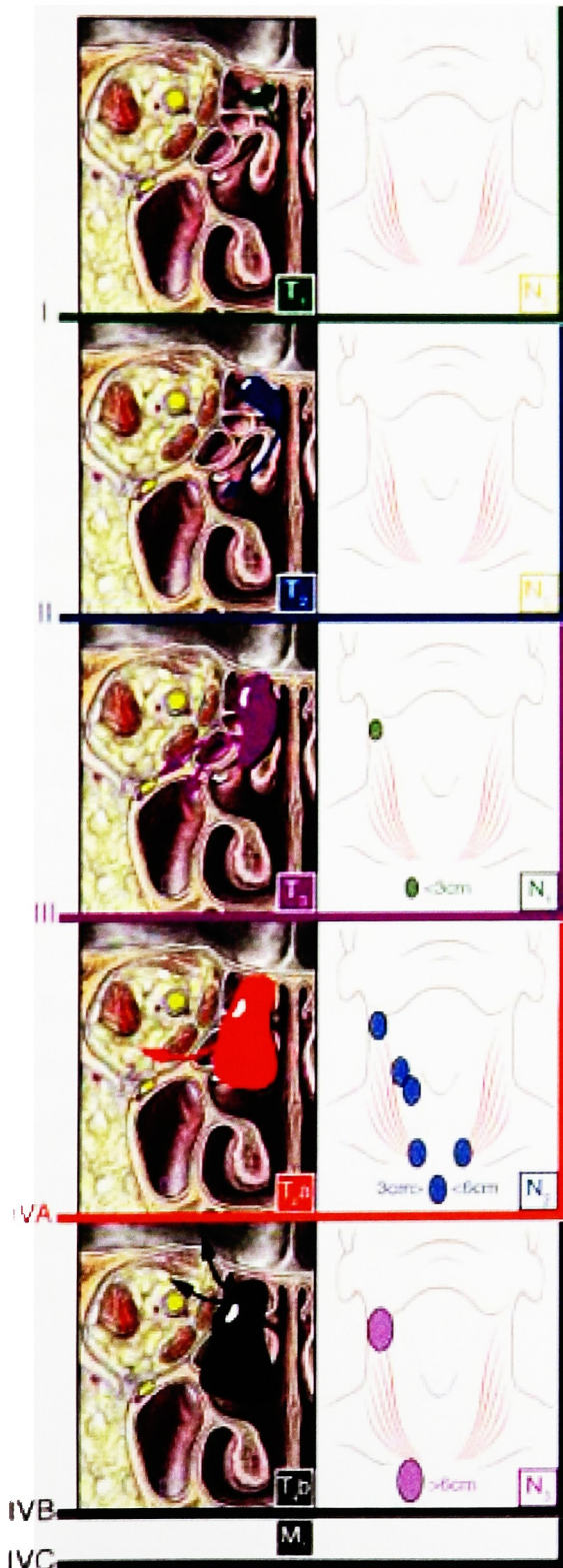


Figure 5.



## **The Author-Artist Negotiations**

As mentioned previously I created these illustrations for the author of the manual. Because this was a 'job' and I was creating this work based on the wishes of someone else, most of these critical decisions were made through negotiations with the author and myself. This was one of the most difficult aspects of the project. I found that the author knew the content and knew how he wanted to present it, but often had difficulty communicating his ideas to me. Only through many rounds of revisions were we able to reach an understanding of what the final artwork should look like. These numerous negotiations resulted in lots of backtracking to chapters that should have been completed much earlier, ultimately leading to repeated late delivery of final products to the publisher and running over time and budget. If I enter into another project of this magnitude again, I will be more strict in the original contract about the number of revisions, in order to successfully meet deadlines.

## **IV. Conclusion**

The TNM System is a very important tool that physicians use every day in a clinical setting to help diagnose, treat and offer prognoses to cancer patients. In order to achieve these goals, physicians need adequate manuals to make this complex system more accessible. The existing TNM manuals are usually unclear, out of date, and contain mostly text and few black and white graphics. It is my hope that the illustrations I have created will improve upon these older visuals and will provide physicians everywhere with a useful quick-reference manual to be used in a clinical setting.

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