

Manuscript Preparation For Scientific Publication*

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Every orthodontist should strive toward a reasonable competence in scientific writing. Manuscript preparation is admittedly a difficult task for most. The author usually finds himself involved in an apparently endless process of sentence revision and rearrangement of the material in an attempt to present the text in concise, understandable and orderly fashion. It is unfortunate, for whatever the reason, that many of us are hard-pressed to put into words the things we are trying to say. It is obvious that the finished text cannot be any better than the experimental findings presented in the paper, but much of the value of excellent research can be lost to the reader if the manuscript is poorly written.

Each and every original paper presented formally before scientific groups is not necessarily of a caliber worthy of publication. In many instances, these papers represent a first effort, exclusive of the so-called term papers of college and dental school days. Personally, I can still recall that I was forced to discard my entire first year's research effort in graduate school and start over again. What I am saying in more or less oblique fashion is that considerable planning should enter into every research project before doing a single bit of the actual study. In the final analysis, manuscript preparation is only

a matter of reasonable acquaintance with the Queen's English and assembly of the data into understandable form. A paper worthy of publication must have contributed to the general body of information in that particular area. The literary diarrhea characteristic of so many papers contributes nothing and even fails to stimulate controversy. From a more positive point of view, if a paper contains but one small step into the unknown, backed by hypothesis and supporting data, it is probably worthwhile.

There is no disgrace in seeking help in setting up experimental protocol before embarking on a project. Additional assistance in assembling the data and preparation of the manuscript will do much toward assuring a meaningful final result.

An orthodontist is judged by the quality of his work whether it be in his completed clinical cases or in the papers he has written for publication. In orthodontics, it has become popular to "measure something". Cephalometry has yielded itself nicely to this urge. As a consequence, all manner of angles and linear dimensions have been tabulated and attempts made to draw conclusions irrespective of whether they have a basis in fact. There is little value in squandering one's time in a series of cephalometric measurements which cannot be interpreted by the author or anyone else. I am afraid too many of us tackle a real or imaginary problem in Don Quixote style. One may be asked to write a paper for the Angle Society; in this there is infinite freedom as long as it has a relation to

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dentistry. Such a bright bold project might, for example, contemplate the investigation of root-end resorption. We can refer to this hypothetical investigation here in writing an equally hypothetical paper. It will be assumed that the data is reliable, of sufficient magnitude, and not shot full of uncontrolled variables. The task, then, is to present the idea, assemble the data, discuss the results, and finally draw, if possible, limited conclusions.

Let us consider the title: its selection may well be left until the manuscript is all but finished. In this case, however, let us assign the title at the beginning. It should give the reader an idea of what he is about to read. A smart title such as "You're at the End with Root-End Resorption" may get attention, but doesn't wear very well. In fact, it would look downright ridiculous. Alliteration is sometimes used; for example, "Root Resorption — Revelation or Retribution", or "Wrecked Roots — the Doctor's Dilemma". For the most part they are not very good. I can recall only one title in which alliteration was used cleverly and to good advantage. That was a paper written by a well-known orthodontist entitled, "Malocclusion — Malady or Malformation". I think this title stimulates one's curiosity and yet tells the reader in succinct fashion the subject of the paper. Perhaps the worst title I know is the one I used in my first graduate paper in bacteriology entitled, "The Immune Response to Parenteral Administration of Undenatured Streptococcal Bacterial Antigen". Had I but added a few words concerning experimental results, I would have had the entire paper right there in the title. I have always been astounded at Dr. Angle titling a paper "The Latest and Best . . .". True, it was the latest, and it turned out to be the best, and perhaps he had reasons

for this title not apparent to us. Nevertheless, once published, such a title is there in the literature to haunt the author as long as anyone cares to bring up the subject.

Specifically, the title should tell the reader as simply as possible what he is about to read. It should include all important nouns under which it can be indexed. The more important words should be at the beginning of the title for easy identification. A practical aid is to ask yourself, "Where would I look in an abstract journal index if I were searching for literature on the subjects treated in my paper?"

A good collegiate dictionary and Roget's *Thesaurus* are almost indispensable in writing a paper. Redundancy and misspelling are inexcusable. There are several texts concerned with writing for publication. I recommend one written by Trelease from which I have borrowed extensively in this paper. It is entitled *How to write Scientific and Technical Papers*.

The first section of the paper is generally concerned with a review of the literature. Search of the literature should have been done prior to final selection of the research problem. If one is unfamiliar with the subject to be undertaken, it is well to consult texts and monographs and *then* proceed with a review of the journals. It is increasingly important to be acquainted with the foreign literature as well as the American dental journals. It is amusing to examine bibliographies in some of the orthodontic literature; one will see extensive "padding", references which the author obviously threw in for good luck. One only fools himself in doing this. At the other extreme there is a textbook written by Sicher in which he has no bibliography or references at all. A thorough review of the literature is a *must* if one is to

do a good job in preparing his research paper. Reference to a few of the more pertinent findings of others in your paper will lend force and emphasis to the presentation of research findings.

It is no longer necessary to recount in each and every paper on the subject that Broadbent gave the profession the cephalometer in 1931, or that Brodie did a serial study of children from birth to eight years of age.

Perhaps the most difficult part of scientific writing is the organization and arrangement of subject matter.

1. The introductory sentence of a paragraph should tell the reader in more or less summary fashion what subject material is going to be developed within that paragraph. An orderly presentation of the topic is necessary if the reader is to follow the argument. Terms should be well defined and concise, logical support given each statement.
2. Clarity and definiteness will help the reader understand what is being said. Illustrations, photographs, charts and graphs can be used to good advantage. Ambiguity can be avoided if the rough draft is gone over carefully by someone who is well informed in the general area under discussion.
3. Word usage seems to be a stumbling block. If there is doubt, and a choice of words is possible in a given sentence, one should use the more common and more definitive word or term. No one is impressed by obscure, ambiguous or archaic language. For example, no one but an orthodontist would know what one means by the term "basal bone." Even the term, osteoid bone, is variously used and interpreted. I have often wondered who dreamed up

the weasel term "dental unit". It must have been someone who was afraid to tell a parent that teeth had to be extracted. If it makes sense to call teeth dental units, then it must be equally correct to say, "Doctor, one of my dental units is aching".

4. Detailed consideration must be given to the logical presentation of ideas. New ideas should be supported by hypothesis. This offers a logical explanation for a given observed phenomenon based on the facts at hand. Trelease points out that it should:
 - a. Be a guide toward additional investigation,
 - b. Explain facts which have heretofore been unexplained,
 - c. Be consistent with the experimental observations,
 - d. Should be no more elaborate than absolutely necessary,
 - e. Help predict new findings,
 - f. Should be subject to verification or refutation.

It is unfortunate that many statements in the orthodontic literature have graduated from hypothesis to the level of general factual material simply by weight of the printed word and authority of the author. Some papers have no need of hypothesis. This would be true of one reporting the statistical compilation of the incidence of root-end resorption in the general population of orthodontically untreated, medically sound persons. On the other hand, there have been a multitude of ill-supported hypotheses purporting to show that root resorption is due to one thing or another.

One must be careful to avoid being drawn into illusions resulting from mechanical, arithmetical and statistical errors. There are those who seem to have a genius for avoiding common sense conclusions, but willing to trust

almost any statistical analysis, especially if it appears to be complicated. I recall a paper published by a graduate orthodontic student a few years ago on the etiology of root resorption in which the main thesis rested on statistical analysis. I like to think I employed common sense in recognizing my own inadequacies about statistics by consulting with an orthodontic colleague who has an excellent command of the subject. He was able to pinpoint the shortcomings of the statistical methods employed and thus laid open to question the author's conclusions which had bothered me only on a common sense basis. The lesson is that there is nothing wrong with statistics, per se, any more than there is, for example, with cephalometry. Both can be applied incorrectly and interpreted even more incorrectly. One should ask for help when necessary and not be afraid to expose his ignorance.

One should avoid broad generalizations. I think it must be our enthusiasm for a particular method of treatment, appliance gimmick or a new idea that prompts us to sell it at a table clinic or in a paper as being 99.44% true, give or take the other fractional percent.

In contemplating the meaning of a set of data, one can be lured into the trap of *cause and effect reasoning*. Just because one event follows another, one should not infer a cause and effect relation. The orthodontic literature is replete with this sort of thing. For example: mouth breathing *causes* narrow dental arches; thumb sucking *causes* Class II malocclusion; faulty sleeping habits *cause* crossbites; incorrect force application in orthodontic treatment *causes* root resorption, and many others. There may be elements of truth in all of these supposed cause and effect relationships, but not much more.

One must try to avoid scientific prejudice in writing although each and every one of us is subject to it. For example, we American orthodontists have a deep prejudice against certain European appliances while their proponents in turn feel sorry for us in using bands on teeth.

Finally, do not base conclusions on unproved propositions or hypotheses. When discussing or arguing a crucial point in the manuscript, try to stick to the question at hand. It is not too difficult to end up reasoning oneself into a position that proves one thing while it really proves something else. For example, I suspect many of us have had or tried to have an earnest discussion with our wives regarding the vicissitudes of the household budget only to have them prove that they really need a mink stole.

The presentation of data is, after all, the backbone of the paper. The inclusion of charts, figures and graphs help the reader only if they are uncluttered and well-arranged. All of these devices must be self-supporting. By that I mean one should be able to understand a chart without reference to the text. Therefore, the chart should have an explanatory title and, if necessary, a legend below. Headfilm tracings in particular have a way of getting cluttered up beyond recognition. Graphs with a half-dozen lines, some straight, some dotted, and some polkadotted are nearly impossible to interpret. Again, keep all figures and charts as simple as possible, eliminating extraneous material.

One is sometimes confused in planning a simple graph or chart in which there are two variables. The rule is that the independent variable is plotted on the abscissa or horizontal axis, while the dependent variable is plotted on the ordinate or vertical axis. For example, a chart expressing

root-end resorption in relation to time of treatment would have the degree of root resorption plotted on the vertical axis and the treatment time on the horizontal. However, if one were plotting treatment time against age, treatment time is the dependent variable and would be plotted on the vertical axis. The text is reserved for discussion and comparisons not obvious in the graphs or charts. One refers to a given chart in the text by pointing out significant findings therein and thereby avoids useless repetition. These findings can then be enlarged upon and generalizations made as indicated.

Let us now mention some of the difficulties encountered in ordinary grammar and sentence construction:

1. Sentences should average about twenty words and preferably not exceed three typewritten lines or about forty words.
2. Simple sentences with normal order of subject, verb and object are preferable.
3. One should use compound sentences (those with conjunctions such as and, but) sparingly, converting them where possible into a sentence with a subordinate clause. This is a useful device to avoid reader confusion which may arise in relating the two halves of an ordinary compound sentence.

The matter of tense is sometimes perplexing. There are no strict rules, but the following general rules are helpful:

1. The experimental facts should be expressed in the past tense, e.g., root resorption was seen in half the cases. To express this finding in the present tense may well infer root-end resorption to be characteristic in fifty per cent of orthodontic cases.
2. The presentation of experimental

findings should be in the present tense wherever possible, e.g., the age distribution for root resorption is shown in Fig. 2.

3. Discussion of the results is generally in both the present and past tense, e.g., the greatest root resorption is shown in Case R.M., who was the oldest patient.
4. Specific conclusions and deductions should be expressed in the past tense. By doing this one emphasizes the special conditions of the experiment and avoids confusion with generally accepted truths. e.g., there was more marked resorption in all cases under treatment for two years.
5. General truths should be in the present tense. For example: a multibanded appliance affords more control in tooth movement than simple removable ones. In this example I have avoided the subject of root resorption because I don't know any general truths concerning the phenomenon.

I will not belabor you with rules of punctuation. But if I were to make a single suggestion, it would be this — when in doubt, use a period. Everyone is supposed to have learned correct usage of colons, semicolons, commas, parentheses and the like in grade school. Punctuation of coordinate or compound sentences, adverbial clauses and relative clauses should be second nature.

Capitalization of nouns is another source of confusion. I think some use a capitalized noun for things they hold in respect. For instance, neither edge-wise appliance nor tip-back bends are capitalized in the middle of a sentence. A medicodental term involving the author's name need not be capitalized if that conforms with common usage. Examples might be: curve of spee, malphigian corpuscle. You will recall

that units of measurement such as ampere and watt and more recently, fermi, are not capitalized.

It is customary to use Arabic numbers for definite weights, percentages and degrees of temperature. On the other hand, it is preferable to spell out indefinite or approximate periods of time. For example, the patient was twelve years old. Never begin a sentence with a figure; either write the number in words or rearrange the sentence. However, figures are used for the day of the month, omitting the rd (as third), th (as eleventh), and st (as twenty-first).

In writing discussions, summaries and conclusions, Trelease wisely suggests watching for the following sources of difficulty:

1. Exaggeration of fact. (Be careful with the words "never" and "always".)
2. Omission of pertinent data
3. Errors in data and calculation
4. Conclusions based on faulty or insufficient evidence
5. Unreliable statistical treatment of data
6. Failure to distinguish between fact and opinion.

We often suffer from the inability to distinguish between fact and opinion. For example: it has been stated in high places that orthodontic expansion would stimulate the growth of bone; that it is impossible to move maxillary molars distally; that extraoral traction inhibits growth of the various sutures in relation to the maxilla; that the eruptive force of the third molar is responsible for mandibular incisor crowding; and many other like statements made in good faith but with insufficient evidence to brand them as general truths. Continued repetition of partial truths through the printed word seems to brand such statements as

general truths until, fortunately, someone comes along and subjects them to closer scrutiny. One must watch for inconsistencies, particularly when generalizing on the experimental data. Don't prove black is black and later on prove it to be white.

We are most likely to publish articles in the *Angle Orthodontist* or in the *American Journal of Orthodontics*. Each of these journals gives the author rules for manuscript preparation. One usually has a particular journal in mind when he is preparing a manuscript for publication and the general format of published articles in that particular journal will be helpful in organizing the material. Above all, don't be afraid to ask for help in experiment planning; then later, seek editorial help. Finally, revise the manuscript until it says what you want it to say.

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