

Integration of Basic Sciences into the Predoctoral Curriculum to Study Temporomandibular Disorders and Orofacial Pain

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This paper outlines several aspects of the integration of basic sciences into the predoctoral dental curriculum. It addresses a number of the points or questions posed by the organizers of the Third Educational Conference to Develop the Curriculum in Temporomandibular Disorders and Orofacial Pain. The importance of the basic sciences for a comprehensive overview of knowledge bearing on temporomandibular disorders and orofacial pain is first emphasized, followed by considerations of what material should be taught and by whom. The paper concludes by considering at what stage of the curriculum this material should be included, how the pertinent basic sciences should be taught, and under what circumstances. Under the term "basic sciences" are included not only relevant biomedical or biologic sciences such as physiology and anatomy, but also the behavioral sciences such as psychology and cognitive science.

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A considerable amount of basic science knowledge relevant to temporomandibular disorders (TMD) and orofacial pain has been produced, especially over the last 25 years. In the past, such advances have often not been adequately transferred to dental students (and practitioners). In recent years there has been an increased emphasis on the importance of the transfer of knowledge and application of scientific principles and evidence-based approaches in clinical dentistry.^{1,2} As in any clinical science or discipline, an educational program of TMD and orofacial pain should reflect a close interrelationship between the clinical aspects of the topic and the basic sciences. The importance of an integrated, multidisciplinary approach to the study and management of pain is now a well-accepted principle, and indeed reflects the inherent philosophy of the International Association for the Study of Pain (IASP).

The basic sciences provide a knowledge base underpinning the clinical educational part of the teaching program, which focuses on diagnosis, treatment planning, and management of pain. Anatomy, physiology, pharmacology, neurosciences, and behav-

ioral sciences are particularly pertinent, and advances in knowledge in these areas have provided important new insights into diagnostic and management principles and approaches for TMD and orofacial pain.³⁻⁷ Indeed, knowledge in a number of related areas, such as inflammation, immunology, growth and development, epidemiology, biomechanics, and biomaterials should be integrated with that in the 5 biomedical areas mentioned above, since this knowledge is pertinent to pain as well as to other clinical fields in dentistry.

What to Teach?

Until recently, an impediment for the predoctoral pain curriculum has been the lack of clear guidelines on the appropriate topics to be taught and the availability of texts dealing with TMD and orofacial pain that are sufficiently comprehensive, up-to-date, and designed for the undergraduate dental student. With the latter in mind, such a textbook has recently been produced that is tailored specifically for the dental student.⁸ Furthermore, the formulation of such texts over the past 10 years has been assisted by the development of guidelines that identify the topics to be taught and the goals and outcomes of a predoctoral educational program that would include a focus on TMD and orofacial pain. Particularly notable are the curriculum guidelines developed at the First Educational Conference on TMD and Orofacial Pain^{9,10} and the proposed model of predoctoral curriculum on pain for dental schools published by the IASP.¹¹ A synthesis of those aspects of the guidelines that pertain to the basic sciences is summarized below. The outline assumes that the student has taken prerequisite courses that have provided him or her with general basic science knowledge, such as general biology, physiology, and biochemistry.

Principal Educational Goals

- An understanding of the main epidemiologic features of TMD and orofacial pain
- An understanding of the basic mechanisms underlying pain and dysfunction in the craniofacial region
- An understanding of the structural, physiologic, pathologic, psychologic, and social factors contributing to TMD and orofacial pain
- An understanding of how the field of TMD and orofacial pain relates to the various dental and health sciences

Outline of Basic Science Curriculum

- Definition of pain terms, philosophical and historical aspects, biologic significance of acute and chronic pain
- Structural and functional anatomy of the temporomandibular joint (TMJ) and associated musculature, and biomechanics of jaw movements
- Peripheral distribution of the nerves of the head and neck, the anatomic relations of the structures that they innervate, and their primary central connections
- Theories of pain
- Receptors and afferents of the trigeminal system and their role in pain
- Brain stem, thalamic, and cerebral cortical processes related to pain
- Related motor centers and sensorimotor mechanisms underlying orofacial movement
- Features that distinguish the trigeminal system from the spinal somatosensory system
- Segmental and higher brain center mechanisms involved in modulation of nociceptive transmission and neuromuscular activities
- Neurochemicals involved in nociceptive transmission, and in pain expression and control
- Affective, cognitive, and behavioral aspects
- Interpersonal and psychosocial issues; illness behavior; and the influence of political, governmental, and social welfare programs

Teaching by Whom?

Since the field of TMD and orofacial pain is multidisciplinary, then dedicated teachers with an appropriate knowledge base in anatomy, physiology, neurosciences, pharmacology, and behavioral sciences could potentially contribute to the basic science teaching of TMD and orofacial pain. There have been and will undoubtedly continue to be rapid advances in the basic sciences relevant to this topic, and so it is implicit that the basic sciences should be taught by those who keep abreast of these advances and bring them to bear in their teaching. The formal credentials of those providing the teaching may be a matter of some debate but is less of an issue, since it appears that there is no clear evidence documenting that a particular pain-related topic—whether it be physiology, psychology, neurosciences, or another biologic or behavioral science—is best taught by a basic scientist in the dental school or in a university's medical school or relevant science department. Certainly in most instances it would be easier for basic scien-

tists in the dental school, especially those who are clinically qualified, to teach the basic science topic and to highlight its clinical relevance where appropriate. Important contributions might also be made by clinical scientists or clinicians with the ability to effectively communicate basic science and translate research findings.

Given these considerations, the selection of those providing the basic science teaching should be guided by the following. The teachers should be (1) aware of the current as well as the past literature and directions of the field, (2) able to synthesize and present clearly the relevant basic science knowledge, (3) cognizant of the clinical issues, and (4) able to present and translate the basic science information in a manner that highlights its clinical implications for TMD and orofacial pain. Such an application of basic science knowledge would also be facilitated if the major points were reinforced in the clinical components of the curriculum or if the educational program was delivered in an integrated manner (see below).

When to Teach?

The educational program should not commence until after the students have a good grounding in the general basic sciences (see above). At that point, the process for sequencing of the basic science teaching vis-à-vis other basic science courses and the clinical courses relevant to TMD and orofacial pain would be dependent to a large extent on the organization of the predoctoral curriculum in each dental school. Whichever approach is adopted, the basic sciences relevant to TMD and orofacial pain should be taught before the students engage in the care of pain patients, so that they have a sound scientific foundation upon which to base their clinical approaches.

There are several processes by which the basic sciences pertinent to TMD and orofacial pain could be taught. A traditional approach would be to present the material after the students have received their course materials in the oral sciences (eg, dental histology, oral physiology, pharmacology, oral pathology, behavioral sciences) and before any instruction in the preclinical and clinical components of this topic. Thus, in most North American dental schools, the course would commence in the second year of the 4- to 5-year predoctoral program. In those countries where the dental program lasts 5 to 6 years, the appropriate commencement time may not be until the third or fourth year. The advantage of this approach is that

there is a systematic presentation of educational material, with each component building upon knowledge gained earlier in the program. This would also help avoid unnecessary duplication of material and presentation of contradictory concepts from individual disciplines (eg, as exemplified in the past in the teaching of occlusion). A disadvantage is that there may be some time lag before the preclinical and clinical components relevant to TMD and orofacial pain are presented, and so this approach may not afford the opportunity for close integration with the basic sciences.

Another common approach that could be adopted for this particular subject matter would be to present the basic sciences relevant to TMD and orofacial pain in each of the oral science courses. There may be some economies of curricular time with this approach, but a comprehensive, integrative knowledge of the basic sciences pertinent to TMD and orofacial pain could be more difficult to achieve for the students.

Yet another approach, which would be a variant of the first, would be to ensure more integration of the basic science, preclinical, and clinical components so that clinical examples are provided in a timely fashion and build upon the basic science information recently presented to the students. The advantage of this approach is that the basic science and clinical topics relevant to pain are presented in a multidisciplinary manner focused on TMD and orofacial pain.

How to Teach and in What Circumstances?

The traditional approach to teach the basic sciences pertinent to TMD and orofacial pain would be based on a lecture format, perhaps with some adjunctive seminar and/or laboratory sessions when considered desirable and useful. However, the topic lends itself to additional approaches that are currently being advocated (and in some schools implemented) and that have some evidence of their value¹; Dr Attanasio alludes to this in his article in this issue of the journal.¹² Examples include problem-based learning, case-based learning, and simulated clinical sessions (eg, the translation of didactic material on the behavioral sciences into practical examples). These would help reinforce principles of the multidisciplinary nature of the topic and the value of self-directed learning. There is nowadays also increasing emphasis on electronic learning and computer-assisted pedagogical approaches that would be of value in the teaching

of the basic sciences pertinent to TMD and orofacial pain.

The matter of “evidence” raised above also highlights the opportunity that basic science teachers have in this and other fields of dental education—namely, to introduce concepts of evidence-based material to dental students. By presenting, where possible and appropriate, the evidence for the basic science topic under consideration, teachers can set the tone for subsequent clinical presentations.

Whatever the learning format(s) used, the support of the dental school administration is of course necessary to ensure adequate staffing, curriculum time, facilities, and resources for the teaching program. It is also essential that those carrying out the basic science teaching have the respect and goodwill of dental school colleagues who appreciate that a good grounding in the basic sciences is essential for students to be able to provide appropriate clinical care to patients with TMD or other types of orofacial pain and who are willing to cooperate so that the educational goals are realized.

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