Mechanical Intrusion of Maxillary Incisors: A Treatment Strategy to be Abandoned?

It is interesting to me that the treatment goals for esthetic dentistry and for orthodontics appear to converge. In restorative dentistry and prosthodontics, much attention is presently being paid to the vertical dimension of tooth display, ie, the amount of maxillary incisors that is showing when a patient is engaged in normal conversation. Dr Zachrisson, having listened to your lectures on esthetics of tooth display in orthodontic patients, I realize that you have changed your treatment strategies for corrections of deep overbite situations in recent years. Thus, you apparently have stopped using active mechanical intrusion of maxillary incisors in your deep overbite cases, and instead intrude the mandibular incisors. Does this mean that you consider the intrusion of maxillary incisors by mechanical means to be an undesirable orthodontic treatment strategy for handling deep overbite cases?

—Sverker Toreskog, Göteborg, Sweden

Björn U. Zachrisson, Oslo, Norway

It is correct that our treatment concepts for deep overbite cases have changed during the past 10 years. Like many orthodontists worldwide, I previously considered intrusion of maxillary incisors to be a cornerstone of deep bite correction. Such intrusion is predictably and easily achieved with utility arches á la Ricketts, intrusion arches á la Burstone, overlay base-arches, and similar approaches. Apparently, too little emphasis was then being paid to the esthetic importance of the vertical display of the maxillary incisors during normal speech or with the lips relaxed.

Reasons for change

There are two reasons why the situation has changed. First, recent studies[1,2] have shown that with increasing age of patients, it is normal that the upper lip will cover more and more of the maxillary incisors (Table 1, Fig 1). Correspondingly, more of the mandibular incisors will show, associated with the aging process. The explanations for these changes are reduction of tonicity and gravity. The upper lip becomes longer and hides more and more of the maxillary incisors, whereas the drooping of the lower lip will expose gradually more of the mandibular incisors. As a consequence, show of maxillary incisors with relaxed lips signifies youth and beauty[3] (Fig 2c), whereas display of mandibular incisors is a characteristic of the elderly (Fig 2d). Tooth display during speech may be equally important for personality expression as tooth display when smiling. The second reason is that research in restorative dentistry and prosthodontics has demonstrated that the most normally occurring and esthetically most desirable arrangement of the maxillary incisors when the patient is smiling is a curve that is parallel to the inner contour of the lower lip.[4,5] This curve is generally called the smile arc or smile line.[6–8] If a patient shows too little of the maxillary incisors and the arc is straight rather than curved, the display gives the impression of a typical static denture that results in the so-called "denture mouth."[9]

Editor's note:
See Dickens et al article in this issue, pages 313–320.

Table 1 Maxillary and mandibular incisor display with lips gently parted (in mm) by age

Age group (y)	Maxillary central incisor	Mandibular central incisor
Up to 30	3.5	0.5
30–40	1.5	1.0
40–50	1.0	2.0
50–60	0.5	2.5
Over 60	0.0	3.0

Modified from Vig and Brundo.[1]

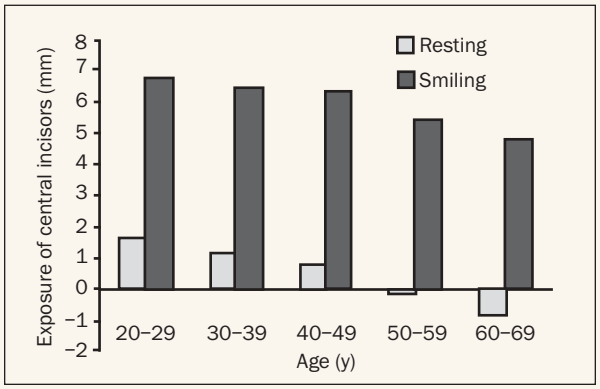

Fig 1 Comparison of maxillary central incisor display by age in resting and smiling positions (from Dong et al[2]).

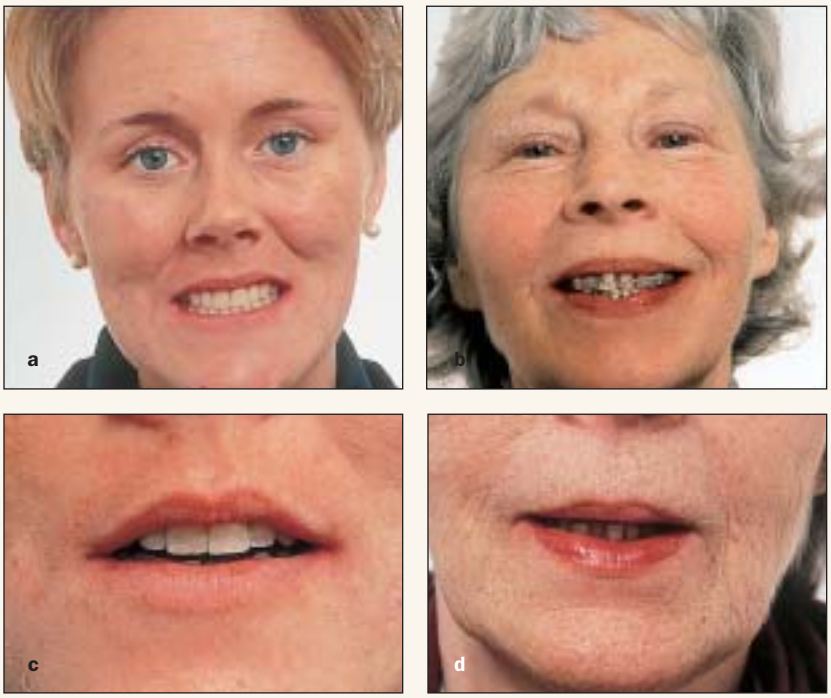

Fig 2 Incisor display in smiling and resting positions in 25-year-old **(a,c)** and 65-year-old female **(b,d)** patients. Note that the tooth display when smiling is not much different between the two patients, but the incisor show with the lips at rest is dramatically dissimilar. The young adult shows only the maxillary incisors, whereas the older adult shows only her mandibular incisors (compare with Fig 1).

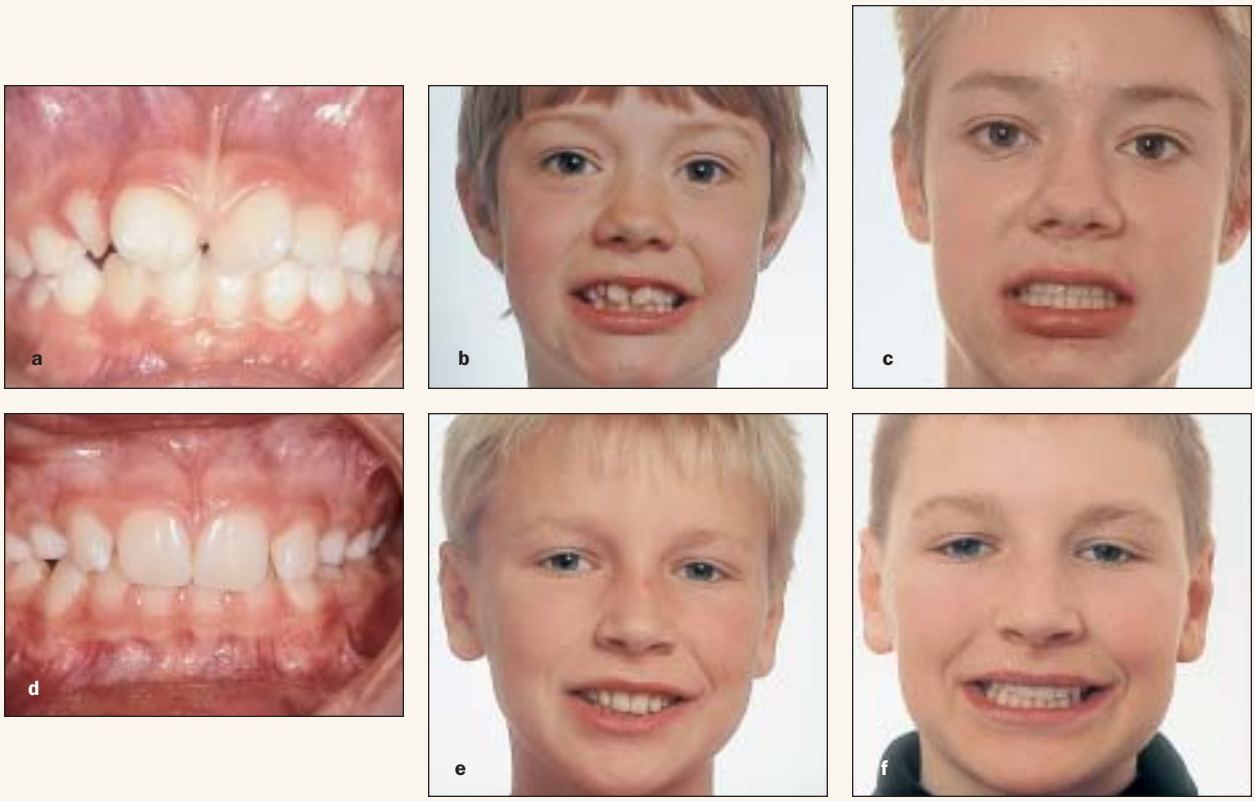

Fig 3 Overintrusion of maxillary incisors in two young orthodontic patients. The pretreatment maxillary incisor positions **(a,b** and **d,e)** should not have been changed vertically. The treatment results **(c,f)** display too little of the maxillary incisors and the smile arcs are too straight.

Message to orthodontists

Marked intrusion of maxillary incisors and positioning these incisors in a straight arrangement (or worse, with a reverse curve relative to the lower lip) may easily give the patient an artificial and aged appearance. Examples of such treatment results are shown in Fig 3. When the patient gets older, this undesirable appearance will not improve, but worsen. Undesirable arc flattening probably is underestimated in orthodontics. Ackerman et al[6] recently found that 32% of their patients got a flattening of the smile arc during orthodontic treatment. One reason why such changes may remain unnoticed by orthodontists is that they are only observed when the patients are examined directly from the front in an "eye-to-eye" view.

Fortunately for orthodontists, few patients know how much of their maxillary incisors they show when speaking. Thus, for any patient, their own tooth display during normal social interactions is largely unknown. When looking in a mirror, few people speak to themselves. Instead, when studying their face and teeth in the mirror, most people use the facial muscles to actively raise their lips. This is similar to the situation when they smile.[2] Since the voluntary smile is an active procedure in which three different muscle groups contribute to raise the upper lip,[10–11] the vertical display of the maxillary incisors during smiling does not change much with increasing age (Figs 1, 2a and 2b).

Normative studies

Some standards of normalcy for maxillary incisor display with the lips at rest are now becoming available. Peck et al[11] showed that the normal display of maxillary incisors at 15 years of age was 4.7 mm (SD 2.0 mm) for boys and 5.3 mm (SD 1.8 mm) for girls. The sexual dimorphism is evident at all ages. This implies that compared to males, females show more maxillary and less mandibular

incisors in all age groups. For adults, Vig and Brundo[1] have provided normative mean values for different age groups (see Table 1). Dong et al[2] compared the age changes in maxillary and mandibular incisor display at rest and when smiling (see Fig 1) and confirmed the observations by Vig and Brundo[1] that the age changes with relaxed lips were dramatic.

Clinical implication

Since no orthodontist would wish to make his/her patients look older than they really are, the implication of these findings is to carefully analyze each patient's tooth display from the front with the lips at rest before deciding whether or not maxillary intrusion mechanics should be used. A more optimal clinical impression may be gained by shooting a short digital video sequence of the patient's face when he or she is talking and saying a few sentences to the camera. For practical purposes, an adequate clinical impression and photographic pretreatment record can be gained by having the patient say "Emma" or "Mississippi," and maintain this lip position for the picture.

In a child or adolescent patient, maxillary incisor intrusion beyond 4 to 5 mm below the upper lip at rest may represent overintrusion of these teeth and unwanted aging of the patient (Figs 3c and 3f). In a young adult between 20 and 30 years of age, there should be at least 3 mm of maxillary incisors showing. For an adult 30 to 40 years of age, approximately 1.5 mm of the maxillary incisors should show at rest position of the lips, and at age 40 to 50 years, about 1 mm. In patients over 50 to 60 years of age, the maxillary incisors normally should not show at all when the lips are relaxed (Fig 1). According to Frush and Fisher,[9] an optimal incisor position in adults occurs when the maxillary lateral incisors show "when the patient is speaking seriously." The tips of the lateral incisors should show in varying degrees according to the sex and age requirements.

Mechanical considerations

To obtain optimal esthetics of patients' tooth display, intruding the mandibular rather than the maxillary incisors would appear to be a better treatment strategy (Fig 4). This is particularly true when the curve of Spee is marked, and when the six mandibular anterior teeth are above the functional occlusal plane at the start of treatment. Mandibular incisor intrusion can be achieved with mandibular utility arches, segmented intrusion arches, overlay base-arches (see Figs 4e, 4g to 4i), etc. The rate of intrusion can be controlled by recording the position of the maxillary central incisor incisal edges relative to fixed points on the mandibular appliances. Using overlay base-arches, it is my experience that mandibular incisor intrusion is slower than intrusion of maxillary incisors; it usually occurs at a rate of 0.5 mm per month. It should be emphasized that it is not possible to effectively intrude mandibular incisors with one continuous archwire. Compared to a conventional continuous archwire, Weiland et al[12] have shown that segmented mechanics (Burstone) will produce overbite correction by *(1)* more incisor intrusion and *(2)* less molar extrusion and subsequent posterior rotation of the mandible. Similarly, AlQabandi et al,[13] when comparing leveling with utility arch and continuous archwire, found the former superior, since the continuous wire produced less true incisor intrusion and more incisor proclination. According to Simons and Joondeph,[14] proclination of mandibular incisors is correlated with long-term overbite relapse.

Another situation that calls for the use of segmented archwires happens in children with limited anterior overbite and concomitant occurrence of maxillary canines erupting in a high position (Figs 5a to 5c). If a continuous leveling archwire is used, the intrusive counterforce on the incisors may overintrude them into functionally and esthetically unacceptable positions. In such instances, a cantilever wire from the extra tube on the first molars, connected with a solid transpalatal bar to yield a reliable posterior anchorage unit, is preferable if an optimal vertical display of the incisors is to be found at the end of treatment (Figs 5d to 5f).

An alternative to incisor intrusion for deep overbite correction may be active molar extrusion. Such effects can be obtained with functional appliances, bite-planes, headgears, etc.[15] Molar extrusion may be of merit in a growing child with normal or low-angle face type and vertical growth pattern,[14] but it would be calamitous in a high-angle case,[16] and cannot be recommended in adults because of stability concerns.[14,17] It is of interest in this regard that the long-term esthetic outcome of bionator treatment generally is excellent, in part due to the fact that maxillary incisor intrusion is not possible and the deep bite is corrected mainly by mandibular molar extrusion[18] (Rudzki-Janson I, personal communication, 1998).

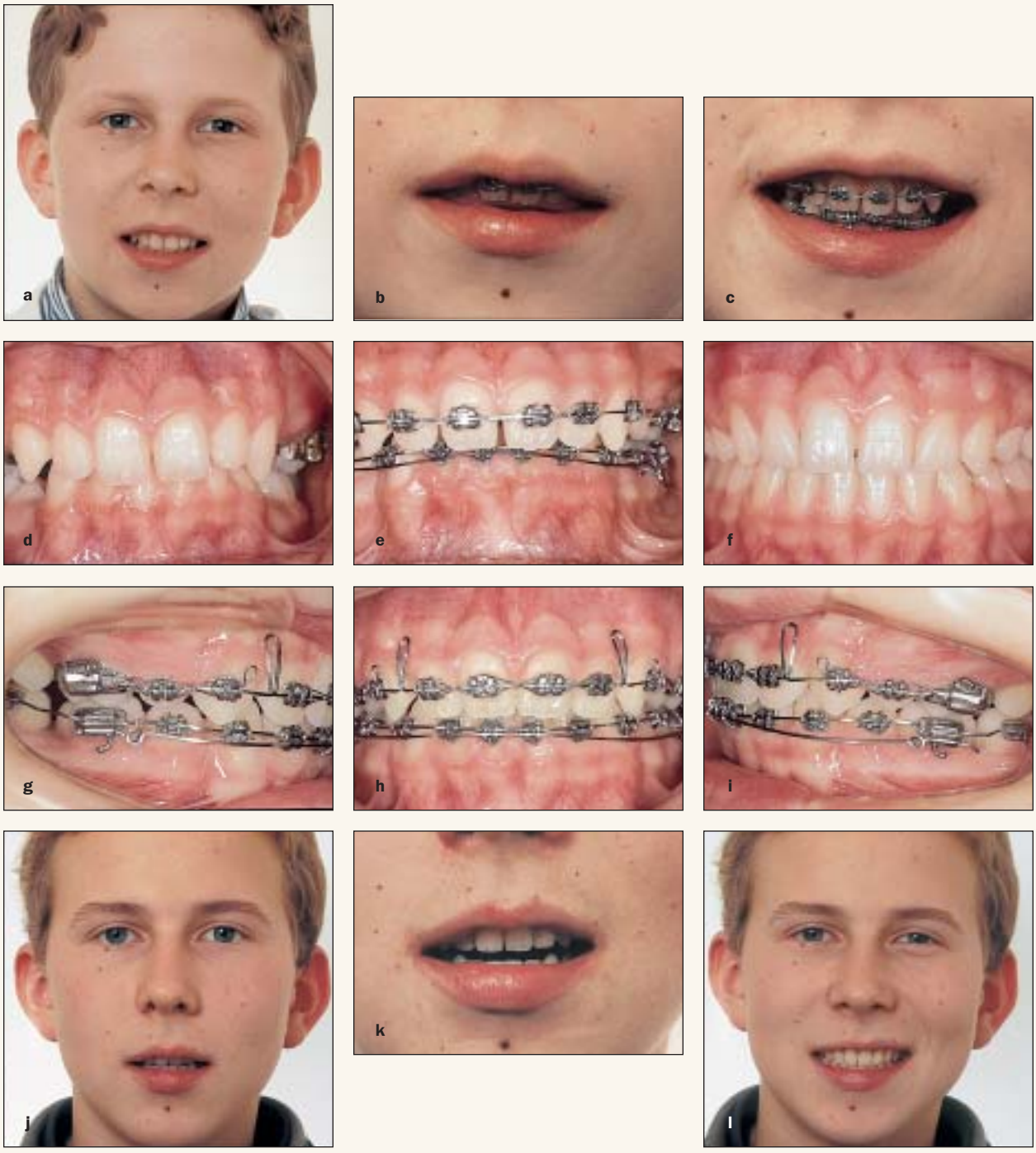

Fig 4 Proper intrusion of mandibular incisors in deep overbite case **(a,d)**. Maxillary incisor display during treatment with the lips at rest **(b)** and on smiling **(c)** is optimal and should not be changed vertically. Overlay base-arches **(e, g to i)** from bonded double tubes on the mandibular first molars were used for mandibular incisor intrusion. Treatment result **(f)** displays optimal amount of maxillary incisors with relaxed lips **(j,k)** and on smiling **(l)**.

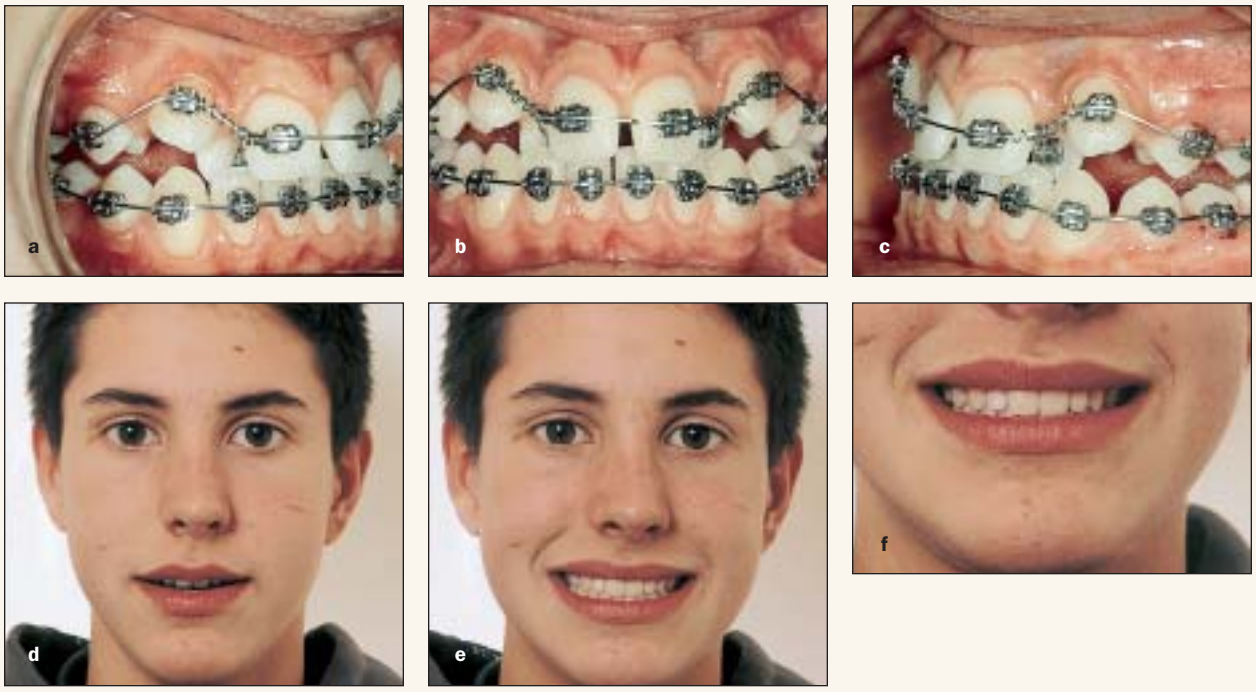

Fig 5 During orthodontic leveling of erupting maxillary canines in patients with reduced anterior overbite **(a to c)**, conventional continuous archwires should not be used, since the counterforce will have an intrusion effect on the maxillary incisors. The continuous wire was replaced with cantilever wires from triple tubes on the first molars to produce an optimal incisor display at rest **(d)** and on smiling **(e,f)** at the end of treatment.

Conclusion

In response to your question, therefore, I would summarize my opinion by stating that the mechanical intrusion of maxillary incisors is not frequently indicated in the average orthodontic patient. Such intrusion does not have to be abandoned as a treatment strategy, but it should always be made with utmost care to avoid overintrusion and to provide an optimal vertical positioning of the maxillary incisors in the face of both the adolescent and the adult patient. Any maxillary incisor intrusion must be made with due respect to *(1)* the tooth display with relaxed lips, *(2)* the show of maxillary incisors with the patient speaking, and *(3)* the actual age and sex of the patient under treatment. Normative values for maxillary incisor display are now available for all age groups.[1,2,11] As a general rule, it is preferable to make patients look somewhat younger than their chronologic age, and it would be detrimental to make them look older. If the finishing of the case involves some incisal edge recontouring for esthetic purposes, I may, even in deep overbite cases, purposely extrude the maxillary incisors beyond the normal age values before the grinding is performed.

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Send it to: *T. M. Graber, Editor-in-Chief*
University of Illinois at Chicago,
College of Dentistry
801 South Paulina, M/C 842
Chicago, Illinois 60612, USA

or E-mail to: *tgraber@uic.edu*