

Facial aesthetics in Orthodontics

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This article was originally published as: More than lip service: Facial esthetics in Orthodontics, in the *Journal of the American Dental Association*, 1999; 130(8): 1173–81. It has been slightly modified. Permission to reprint was kindly granted by ADA Publishing, a Division of ADA Business Enterprises Inc.

Current trends in orthodontic care emphasise alternatives to the extraction of premolars, despite a lack of support from the refereed literature for many of the non-extraction treatments. Anecdotal reports published in non peer-reviewed journals have called into question the aesthetic effects of extraction treatment. As calls for evidence-based treatments increase throughout dentistry, reports on the effects—both positive and negative—of different orthodontic options have appeared in growing numbers. Given the results of a variety of reports in the peer-reviewed literature, it may be concluded that orthodontic treatment involving extractions can produce improved aesthetics for many patients who have some combination of crowding and protrusion. However, careful diagnosis followed by evidence-based treatment decisions should be the accepted clinical norm as the specialty of Orthodontics embarks on its second century. Aust Orthod J 2001; 17: 17–26

Orthodontics is concerned with facial form and appearance. In the late 1800s, the father of modern orthodontics, Dr. Edward Angle, a devout nonextractionist, saw the bust of Apollo Bevedere (Figure 1) as the epitome of facial beauty and the gold standard that guided his treatment.¹ Angle believed that every mouth could accommodate all 32 teeth and, therefore, he contended that proper orthodontic treatment involved dental arch expansion. Interestingly enough, the late Elvis Presley appears to be the only contemporary popular icon who exhibits a similar profile. Indeed, if we were to critique this sort of profile in light of the current nonextraction-at-all-costs climate, some might say that Apollo and “the King” had had an unfortunate encounter with an “extraction orthodontist.”

The fear of the “dished-in” profile, said commonly to result from the extraction of premolars (Figure 2), is derived largely from isolated lawsuits and carefully selected reports of unfavorable results.^{2–6} Unfortunately, the allegation that the techniques of traditional orthodontics regularly “flatten” facial profiles and produce temporomandibular joint disorder, or TMD, have significantly altered today’s orthodontic treatment plans. Extraction rates have decreased, despite the absence of a rational theoretical basis or support from refereed scientific literature for such actions.⁷ In the process, increasing numbers of orthodontists have eagerly assayed all manner of treatment methods designed to avoid premolar extractions. In many instances, these efforts appear designed to prevent lost referrals or to preclude legal difficulties, rather than to avoid some proven defect in conventional treatments.

Unfortunately, most of the alternatives to extraction—arch expansion or development, “flaring,” or bite jumping—have more in common with orthodontics of the 19th century than what we might expect to see in the 21st century. Many, if

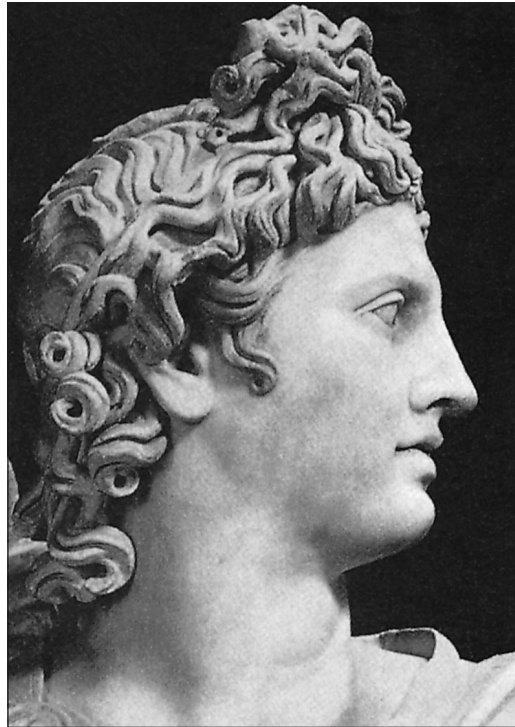


Figure 1. Apollo Belvedere (Vatican Museum), a Roman marble copy of a lost fourth-century B.C. Greek sculpture, was long revered as a standard for Western aesthetic values (Reproduced with permission of the Vatican Museums)

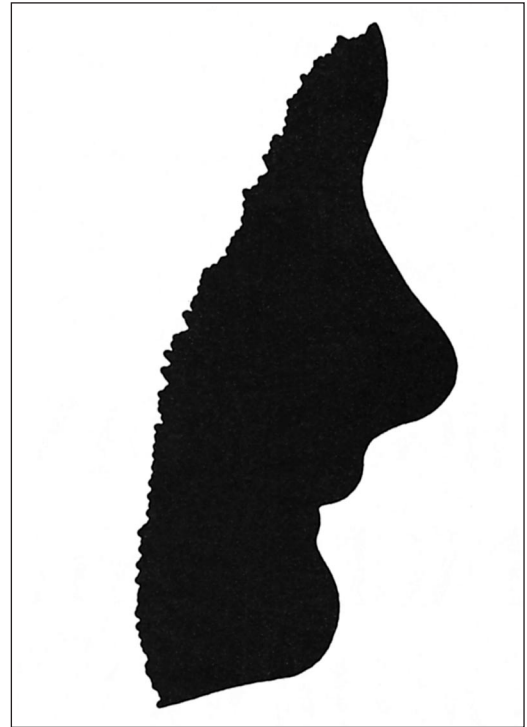


Figure 2. Selected example of facial esthetics adversely affected by extraction orthodontics as reported by Witzig and Stahl² and depicted by Drobocky and Smith.¹⁰ In a Washington University study of 160 patients who had undergone extraction,¹⁰ randomly selected from a variety of orthodontic practices, none demonstrated facial measurements as extreme or as unusual as this anecdotal case. (Reprinted by permission of the publisher from Drobocky and Smith).¹⁰

not all, of these older treatment methods were discarded decades ago by insightful orthodontists such as Charles Tweed, P. R. Begg, Robert Strang, Hays Nance and Calvin Case because of instability, poor facial aesthetics and iatrogenic or undesirable periodontal effects. More to the point, orthodontists long ago challenged Angle's "arch development" concepts and began to extract teeth to improve poor facial aesthetics and to avoid creating bimaxillary protrusion. It seems as though orthodontists have forgotten orthodontia's history lessons and thus will be forced to repeat them.

Does extraction harm facial appearance?

Researchers at the University of Iowa⁸ enlisted the assistance of 39 laypeople to evaluate a sample of 91 orthodontic patients, among whom 44 had undergone extraction and 47 had not. Both types of orthodontic treatment—extraction and nonex-

traction—were perceived to have had produced a favorable impact on facial appearance. Each patient's treatment had been selected on the basis of specific diagnostic criteria that argued sometimes for extraction and sometimes for nonextraction. Under these conditions, both treatments produced beneficial aesthetic changes.

According to commonly accepted criteria, premolar extractions sometimes may sometime be a necessity, especially if reduction in protrusion is a treatment goal. In an assessment of the profiles of 40 pre-adolescent patients, based on the Steiner, Merrifield and Ricketts cephalometric analyses, it was suggested that 50 per cent might benefit from some profile reduction.⁹ The necessary lingual incisor movement, however, requires space of the amount commonly achieved by extraction. The proclination associated with expansion strategies would be inappropriate if profile improvement is desired by patient and practitioner.

Washington University investigators¹⁰ examined 160 orthodontic patients who had had premolar extractions. On the basis of soft-tissue measurements, the researchers concluded that 90 per cent of the facial profiles were improved by treatment or at least left unchanged (Figure 2). Similar results were reported at the University of Murcia, Spain.¹¹ Young and Smith¹² compared 198 orthodontic patients who had not undergone extraction with patients in the Washington University extraction sample. They found that both types of treatment tended to produce similar facial results. In other words, if based on sound diagnostic criteria, extraction was not found to be detrimental to facial aesthetics.¹² This might be expected, given that normal facial growth often produces more profound effects on the profile than does the relatively brief phase of orthodontic treatment.¹⁰

If extraction treatment regularly produces negative facial changes, this impact should be obvious to experts in facial aesthetics. Researchers at the University of Mississippi¹³ compared three randomly chosen samples of patients who had had orthodontic treatment involving extractions, patients who received orthodontic treatment but had not had extractions, and patients who had received no orthodontic treatment, fifteen subjects in each group. Forty general practitioners individually evaluated the 45 post-treatment facial profiles presented in random order. The observers could correctly identify the patients who had had orthodontic treatment of any kind 52 per cent of the time. In identifying the patients who had undergone extractions, the dentists were accurate 49 per cent of the time. Orthodontic specialists fared little better, demonstrating 55 per cent and 52 per cent accuracy in identifying patients who had had orthodontic treatment but no extractions and the patients who had had extractions, respectively. In other words, a coin toss would have been about as good.

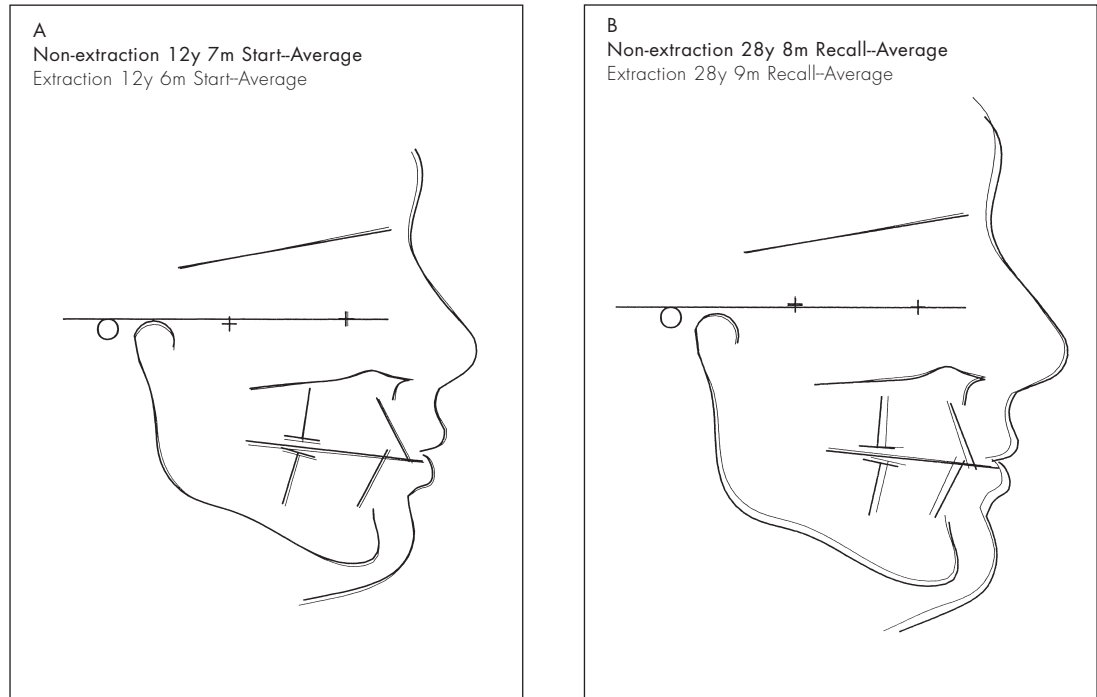
Interestingly enough, a subset of general dentists who emphasized orthodontics in their practices were more likely to identify patients erroneously as having had extractions if they exhibited "flat" facial profiles (such as those of Apollo and Elvis Presley). Misidentification by this group was significantly higher ($P < 0.03$) than by the other practitioners tested. In the end, presumed experts in facial aesthetics of many stripes were unable to perceive any systematic detrimental effects of orthodontic treatment involving premolar extractions.

Facial aesthetics: the patient's view

Given the well-documented trend toward nonextraction treatment, dental professionals and laypeople may have come to view facial and smile aesthetics differently.¹⁴⁻¹⁷ Among celebrities, the general public appears to find aesthetically appealing a range of profiles that run from flat to full —Jacqueline Onassis; Diana, Princess of Wales; Chelsea Clinton; and Mick Jagger.¹⁸ Perhaps dentists have been sensitized to features that may not be of significance to the general public.¹⁹ Parents of orthodontic patients, for instance, are more accepting of untreated facial profiles than are orthodontists.¹⁶ Although patients rated Class II and III profiles as less pleasant than Class I profiles,²⁰ they also were less critical than professionals,^{17,21} a finding that emphasizes the need to involve the patient in the treatment planning process. Given the public's apparent flexibility and tolerance, it would be an important finding if extraction-based orthodontic treatment produces results that are seen as consistently detrimental.

Oynick²² asked panels of observers to evaluate the treatment results for 50 patients with Class II, Division 1 malocclusions, some of whom had extractions and some of whom had not. The pre- and post-treatment profiles were shown to 50 adolescent and 50 adult laypeople and to 10 orthodontic instructors. Approximately 62 per cent of the extraction profiles and 50 per cent of the nonextraction profiles were thought by the entire panel to have been improved by treatment. A subsequent evaluation of 120 Class I and II extraction and nonextraction cases by two panels, one consisting of 42 dentists and the other of 48 laypeople, produced similar results.²³ In this instance, 63 per cent of extraction profiles, but only 27 per cent of nonextraction profiles, were believed to have benefitted from treatment. The results from these two studies imply that both the public and dental practitioners see a positive impact resulting from extraction treatment for patients whose dentition is crowded and/or protrusive. However, both extraction and nonextraction treatments may prove detrimental to facial aesthetics if wrongly applied.

Researchers at Saint Louis University²⁴⁻²⁷ have published a series of articles detailing a long-term comparison of the effects of extraction and nonextraction treatments. Based on initial records, a sample of 63 patients was identified by discriminant analysis as having been equally susceptible to the two different treatment strategies. In other words, with respect to selection of extraction as a treatment method, the two groups were "borderline."



Figures 3a and 3b. Averaged profile tracings of Class II patients whose cases fell on the borderline between extraction and nonextraction (averaged tracings superimposed on Frankfort horizontal and registered at pterygoid vertical). A. Initial tracing. B. Tracings done at recall visit. Thick lines represent facial contours that would argue for nonextraction treatment, thin lines represent contours that would argue for extraction. Note that before treatment, both groups' tracings were essentially identical; after treatment, the profiles of the nonextraction patients were, on average, about 2 mm more procumbant. (Reprinted by permission of the publisher from Paquette, Beattie, and Johnston).²⁴

These patients were recalled an average of 14 years after treatment and were asked to examine randomly ordered tracings of their pre- and post-treatment profiles (Figure 3) and to choose the profile they found more attractive. Only half of the patients who had not undergone extraction thought that treatment had improved their profile, whereas 58 per cent of the patients who had undergone extraction believed the same (the extraction case results also tended to be more stable over the long-term).

These patients also were asked to evaluate their pre- and post-treatment frontal facial photographs. In this instance, 69 per cent of the extraction patients believed their faces were improved through treatment; 57 per cent of the nonextraction patients reported the same.²⁴

Although these success rates are only a little better for the extraction treatment, the point here is that extraction clearly did not "dish in" the profiles on a routine basis as posited by the so-called "functional orthodontists."²⁻⁶ These results are all

the more interesting given that although these patients were treated between 1960 and 1980 and, therefore, many of them would never undergo extractions today, they still exhibited positive results.

When researchers compared patients at either end of the extraction spectrum—those clearly in need of the treatment versus those clearly not—they found that those who were treated with extraction exhibited flatter profiles (Figure 4).²⁵ The patients with a clear-cut need for extraction often had a chief complaint of significant protrusion that they wished to have reduced. Thus, it was the profiles of the patients in need of extraction that were fuller after treatment.^{13,25} Comparable findings were reported by James²⁸ in an evaluation of 170 consecutively-treated patients and by investigators at the University of Iowa⁸ in an evaluation of 91 patients.

A similar comparative extraction/nonextraction study was repeated at the University of Michigan with a sample of black ex-patients. This study, too, noted many distinct benefits of extraction as

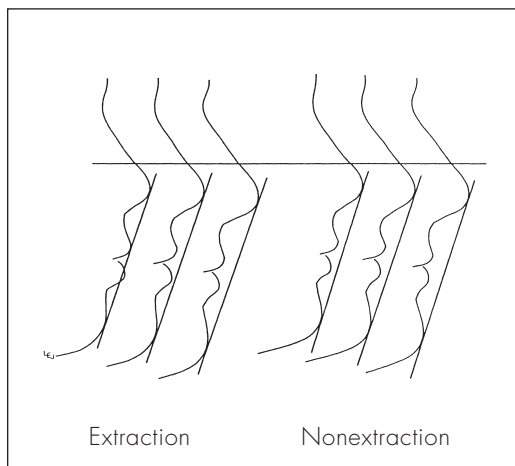


Figure 4. Mean start, finish and recall averaged tracings for extreme (as opposed to borderline) extraction and nonextraction samples. At a post-treatment recall visit, the nonextraction subjects demonstrated “flatter” profiles. (Reprinted with permission of the publisher from Lupanapornlarp and Johnston).²⁵

a treatment for bimaxillary protrusion.^{29,30} These findings were supported by research by Caplan and Shivapuja,³¹ who concluded that extraction will result in an improvement in patients “desiring a less protrusive profile.” It is important to note that blacks appear to prefer a flattening of the profile, but not as retrusive a profile as those preferred by white patients.²⁹ In the end, however, only premolar extraction had any marked capacity to produce a reduction in lip protrusion and, hence, a perception of profile improvement for whites and blacks who have bimaxillary protrusion.^{22,23,29}

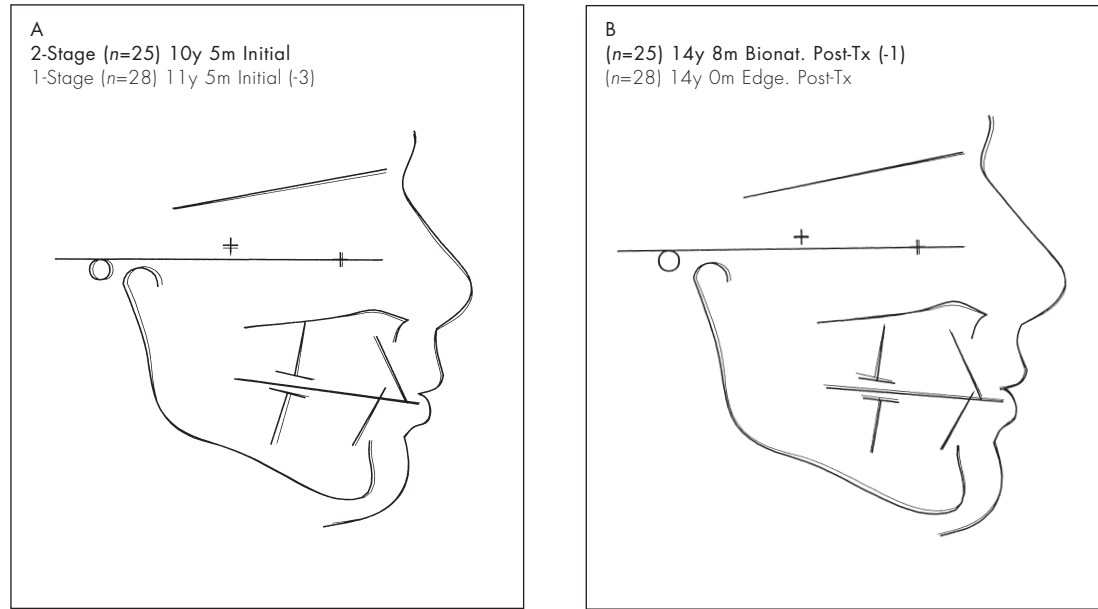
Panels of laypeople and dental practitioners evaluated the pre- and post-treatment profiles of patients who had either extraction or nonextraction treatment.^{23,29} The impact of premolar extraction was shown to be a highly significant function of initial protrusion of the facial profile. Specifically, both panels of evaluators saw extraction as being preferable when, before treatment, the lower lip is more protrusive than 2 to 3 mm behind the Ricketts’ E-plane (the line from the tip of the nose to the most anterior prominence of the chin) for whites²³ and 2 to 4 mm in front of the E-plane for blacks.²⁹

Are there “extraction” smiles or profiles?

Recently, Boley³²⁻³⁴ posed an interesting question: is there really a profile or smile that is pathognomonic of premolar extraction? To address this question, he tested “knowledgeable” orthodontists to determine their ability to ascertain the method of treatment used (extraction or nonextraction) simply by examining the patient’s post-treatment smile or profile. Two hundred practitioners were shown photos of 100 finished cases, one half involving extraction and one half not, including 50 color slides of smiling faces and 50 black-and-white profile and front views. The orthodontists were correct in identifying patients who had had extractions only 52 per cent of the time when they evaluated the smiles and only 44 per cent of the time when they were shown facial profiles. Again, they could have done about as well simply by flipping a coin.

It is perhaps significant that, during his treatment of these patients, Boley³²⁻³⁴ deliberately maintained arch form and inter-canine width. In other words, there was no expansion or “arch development.” As seen in studies at Saint Louis University,²⁴⁻²⁷ the University of Stellenbosch, Republic of South Africa;³⁵ the University of Tennessee;³⁶ and the University of Toronto,³⁷ patients who did not undergo expansion seemed to demonstrate more post-retention stability than mixed samples of patients who did and did not undergo expansion, such as those described by the University of Washington.³⁸

Functional orthodontists, however, do not limit their criticism only to the facial profile. It has been suggested that extraction treatment creates dark intra-oral spaces (“negative space”) at the corners of the mouth that are said to be obvious during smiling^{2,39} and are ascribed to a narrowing of the dental arch. Johnson and Smith,¹⁹ however, evaluated the outcome of treatment in 60 patients who underwent extraction and 30 who did not. A panel of 10 laypeople rated the aesthetics of the post-treatment results from frontal “smile” photographs. Their ratings were unrelated to any measure of width of the dentition or width of the mouth during smiling. The results of this and other studies^{40,41} indicate that there is no predictable negative relationship between the extraction of premolars and the aesthetics of the smile. In fact, there was little change reported in the arch dimensions of the maxillary anteriors in either extraction or nonextraction.²⁴ Thus, the claim that dark-spaces at the “buccal corridor,” or corners of a smile, are a routine result of extraction treatment appears to be mischievous nonsense.



Figures 5a and 5b. Average tracings, magnified to compensate for age-related size differences, of the profiles of Class II patients who received one-stage treatment using fixed appliances and two-stage treatment using a functional appliance and then fixed appliances. A. Initial tracing (magnified 3 per cent). B. Tracing done at recall visit (magnified 1 per cent). Thin lines represent one-stage treatment; thick lines represent two-stage treatment. Note that, on average, the basic facial form for the groups was the same before and after treatment. (Reprinted with permission of the publisher from Livieratos and Johnston.⁴⁶)

What is the “butcher’s bill” for premolar extraction?

On average, the major effect or cost of premolar extraction orthodontics appears to be a flattening of the profile by about 2 millimeters.^{23-27,29,30} Although a 2 mm reduction is a clinically discernible change, it hardly amounts to “dishing in” the profile. Indeed, it commonly is a welcome change that the patients themselves often seek when they request treatment. In most instances, over-flattening is a by-product of faulty diagnosis and treatment planning, not a failure to rely solely on nonextraction treatment. In the end, no treatment is so good that it cannot be misused and misapplied.

The search for extraction alternatives

Recently a series of techniques has been promoted as alternatives to premolar extraction (for example, early treatment and functional, arch development and multi-phase techniques). As noted by J.M. Broadbent,⁴ “Orthodontists...who recognize the limitations of traditional treatment are combining arch development using air-rotor reduction and second molar replacement, European active plates, and functional jaw ortho-

pedics (FJO) appliances with fixed appliance treatment... A synthesis of FJO and fixed appliances may obtain beautiful results which are not possible from fixed appliances alone.”

It is easy to make florid claims; however, it is a bit more of a challenge to produce supporting data.

Although it is possible that functional appliances may alter facial growth, the magnitude of such change appears clinically insignificant and entirely comparable to that produced by more traditional methods.⁴²⁻⁴⁵ In an evaluation of one-stage (fixed) and two-stage (functional-fixed) Class II treatments, investigators at the University of Michigan⁴⁶ found that both treatments produced skeletal and facial changes that left the patients indistinguishable from each other by the type of treatment they had received (Figure 5). In contrast to the beliefs of the functional orthodontists, an early phase of functional appliance treatment appears to provide no unique benefits.^{46,47} As stated succinctly by Paquette *et al.*,²⁴ “Given that many of the stated goals and effects of functional orthodontics seem to be based more on wishful thinking than on real-world data, this outcome should come as no surprise.”



Figure 6. Example of a patient initially treated with the popular goal of “not removing premolars,” resulting in bimaxillary protrusion and lip strain.

The concept of “arch development” to avoid extractions and to produce wider-than-normal smiles also fails to impress, given the numerous reports of frank instability^{35,48-62} and the potential for producing untoward periodontal effects.⁶³⁻⁶⁸ These reports are especially significant, given the existence of more conservative space management alternatives to reduce the percentage of extractions.^{9,69-76} It has been reported that at least 75 per cent of crowded cases can be treated without extraction, without expansion and with superior long-term stability by proper management of leeway space.^{9,70,77} Significantly, to provide a substitute for the 5 mm of space in each quadrant produced by premolar extraction, arch development would require 12 mm of stable expansion,⁷⁸ an amount that is nearly an order of magnitude larger than anything that can be inferred from the literature.⁷⁸

Conclusion

A review of the refereed literature provides little support for the viewpoint that premolar extraction has a routinely negative impact on facial aesthetics and the functional health of the muscles and joints.^{23-29,79-82} Unfortunately, the rules of evidence are often conveniently ignored in today's

orthodontic marketplace.⁸³⁻⁸⁵ Given a lack of support in the refereed literature, it may be argued that the groundswell of enthusiasm for nonextraction treatment is a threat to the public's best interests. Consequently, it has been proposed that the patient who has crowding and protrusion may be most at risk of experiencing a poor result by undergoing some type of ineffective nonextraction treatment (Figure 6).^{23,24} I would maintain that the extraction decision should not be a political one, but rather should be designed to provide the benefits of aesthetics, function and stability in as conservative and timely a manner as possible.

If one believes that the elimination of extraction treatment is a goal more important than that of addressing the patient's chief complaints concerning protrusion, and if one is unconcerned with the possibility of pushing roots through cortical plates or of poor long-term stability, one can elect to treat all patients without using extraction. However, those who believe in avoiding extraction at all costs should give thought to the possibility that their only ethical option in many patients with crowding and protrusion would be either to refer or to render no treatment at all. In this line of argument, Johnston⁸⁶ has noted, “The take-home message here is not that nonextraction is bad or that extraction is universally good, but that extraction is a really good treatment in the kinds of faces that appear to need extraction (that is, [those with] crowding and protrusion). Orthodontists are not condemning patients to overly flat faces and a life of TMD by extracting.”

In conclusion, skepticism is as important to the selection of treatment methods as it is in weighing the merits of a new bracket or a new practice location. The “facts” as inferred from uncontrolled experience may not represent the truth. As Rushing *et al.*¹³ have counselled, “When something new comes along, ask ‘what's the catch,’ and be persuaded by evidence alone, rather than the strong unsubstantiated claims of people who are in a position to influence us.” Failing this, the patient pays a heavy price for our willingness to select treatments without reference either to logic or to evidence.⁸⁷

Acknowledgements

Thanks to Dr Lysle E. Johnston, Jr, the Robert W. Browne Chairman of the Department of Orthodontics and Pediatric Dentistry at the University of Michigan, Ann Arbor, for his assistance in the preparation of this manuscript.

Biography of author

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