Problems associated with ceramic brackets suggest limiting use to selected teeth

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Ceramic brackets were introduced as esthetic appliances which, unlike plastic brackets, could withstand most orthodontic forces and resist staining. Several ceramic brackets are available, all of which are composed of aluminum oxide. Polycrystalline ceramic brackets are made of fused or sintered aluminum oxide particles, whereas monocrystalline brackets contain a single crystal of aluminum oxide.[1,2]

Single crystal sapphire is harder and has higher tensile strength than polycrystalline alumina. However, bracket hardness is not sought for clinical advantage, as metal brackets are sufficiently strong to withstand orthodontic forces and can be debonded without major technical or mechanical problems.[2] Commercially available ceramic brackets are listed in Table 1 according to their composition as mono- or polycrystalline aluminum oxide products. Flores and co-workers compared the fracture strength of polycrystalline GAC Allure and Unitek Transcend brackets to the monocrystalline A Company Starfire and Ormco GEM brackets.[3] They suggested that the polycrystalline brackets were more suitable for orthodontic use than the monocrystalline brackets because the polycrystallines' strength did not drop dramatically following scratching. The scratching presumably simulated scratches which are likely to occur during manufacture, ligation and arch manipulation.

Mechanisms for bonding ceramic brackets include mechanical retention, chemical bonding or a combination thereof. Mechanical retention is achieved through indentations and/or undercuts in the bracket base (e.g. Transcend 2000 Series). To obtain chemical adhesion between ceramic bracket and bonding agent, glass is added to the aluminum oxide base and treated with a silane coupling agent which acts as a molecular bridge linking inorganic fillers to organic polymers (e.g. original Transcend and most first generation ceramic brackets other than GAC Allure, which combined mechanical retention with chemical adhesion.)

Abstract

Ceramic brackets became popular as esthetic appliances which could withstand orthodontic forces and resist staining better than plastic brackets. Several clinical complications may arise from the use of ceramic brackets. They include the effects debonding can have on underlying enamel, attrition of teeth occluding with ceramic brackets and increased friction in the orthodontic appliance. Solutions to these problems are discussed which indicate the need for careful selection of teeth to be bonded with ceramic brackets.

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Key Words

Ceramic • Brackets • Problems • Indications • Debonding

Potential problems

The fracture toughness of enamel is lower than that of ceramic.[4] Rigid, brittle ceramic brackets bonded to rigid, brittle enamel have little ability to absorb stress.[2] Consequently, manufacturing companies have been continuously modifying bonding characteristics of ceramic brackets to compensate for their brittleness and potential difficulties in debonding. Reports of these and other problems have prompted the American Association of Orthodontists (AAO) to properly and responsibly take the lead in bringing to the attention of practitioners "potential health and safety risks to patients".[5-7] Indeed, based on a survey conducted by the AAO in December 1988, the Association recommended including the following oral or written statements in the informed consent meeting with the patient and/or parent:[5] "There have been some reported incidents of patients experiencing bracket breakage and/or damage of teeth, including attrition, enamel flaking on debonding, and enamel fracturing..." The AAO is promoting dialogue and cooperation with the suppliers of ceramic brackets to improve clinical performance and eliminate side effects of their products.[5-7]

In this paper, the author reviews and suggests solutions to various clinical complications that may arise from the use of ceramic brackets. These problems include the effects debonding ceramic brackets can have on the underlying enamel and related patient response, the attrition of teeth occluding with ceramic brackets as well as increased friction with these brackets.

Clinical implications

Problem 1: Enamel fracture and flaking or fracture lines in enamel during debonding.

This problem is related to the high bond strength of ceramic brackets. Enamel fracture and flaking on debonding seems to be associated with sudden impact loading.[8,9] The high bond strength related to ceramic brackets predisposes to such loading. The ideal ceramic bracket would have reduced but adequate bond strength to minimize potential risks of careful or accidental debonding while withstanding orthodontic forces.

Solution A: Avoid sudden impact loading or stress concentration within the enamel by using proper debonding techniques.

The best available guidelines are those suggested by the manufacturer. Different areas of load applications lead to different distributions of stress within the enamel or adhesive zones.[10] Debonding of small teeth (e.g. mandibular incisors) may pose higher risks of tooth fracture than dealing with larger teeth.[11] Ideally, stress should be distributed primarily to the bracket and not the tooth. If the load application tends to fracture ceramic brackets, breaking the adhehive-bracket interface would probably minimize damage to the enamel surface. Swartz recommends applying a slow peeling force at the base of ceramic brackets with (mechanical) interlock, and a slow gradual compression mesiodistal to the base of brackets with chemical adhesion.[2] In the latter case, he speculates that crack propagation is favored to occur within the adhesive rather than the enamel.[2] Controlled research should test all the previous hypotheses.

Solution B: Do not bond ceramic brackets on structurally damaged teeth.

Crack lines, heavy caries, large restorations, hypoplasia and hypocalcification should be contraindications to bonding with ceramic brackets. Joseph and Russouw[12] speculated that the use of ceramic brackets on nonvital teeth could cause a higher incidence of enamel fracture at debonding. Proper investigation is needed, however, to establish the extent to which endodontic treatment may jeopardize the strength of a tooth and consequently the indication for its bonding with a ceramic bracket. In addition, crowns — whether they are made of resin or porcelain — may break when ceramic brackets are debonded. Patients must be informed of this possible eventuality.

Solution C: Reduce bond strength

Add mechanical retention

Bond strength can be reduced by the addition of mechanical retention. Ghafari and Chen[8] tested torsion and shear strength of the original Transcend (chemical retention only) and Allure III (mechanical and chemical retention) brackets. During the torsion test, Transcend bracket failure occurred predominantly at the base/resin interface. Three out of five brackets broke. This result suggests that the chemical bonding inherent with Transcend brackets stresses the rigid, brittle bracket causing failure to occur within the ceramic or — in a separate, individual case of sudden impact loading — within the enamel. The authors proposed that increased mechanical retention might reduce the side effects of debonding by favoring failure within the adhesive itself. The Allure brackets failed mainly at the adhesive/enamel interface corresponding to the area of six mechanically retentive recesses in the bracket base. Viazis et al.[13] reported similar findings, also suggesting that mechanical retention in ceramic brackets (Allure, GAC; GEM, Ormco) favored failure upon debonding within the adhesive itself.

Whether bond strength is related to the type of surface preparation for mechanical retention still needs to be determined. Deep undercuts, recesses or grooves may favor failure within the adhesive itself by increasing the thickness of the adhesive under the bracket base. A few investigations support this hypothesis on the basis of findings of debonding Allure III and GEM brackets, both of which have deep recesses or grooves in the base.[8,13] On the other hand, mechanical retention through rough spheres or crystals of glass fused to the bracket base giving it the appearance of a fibrous surface (Transcend 2000, Unitek; Lumina, Ormco, — Table 1) may predispose to bond failure at the bracket/resin interface. The Allure IV, which has "dimpled" recesses in the base, may have characteristics similar to the latter category.

In a recent investigation, Ghafari, Skanchy and Mante compared the shear bond strength of the Transcend 2000 (fibrous mechanical retention only) and Allure IV (mechanical retention with 12 recesses in the base plus chemical retention) in paired sets of maxillary premolars.[14] The mean bond strength values were high and the standard deviations large for both brackets, although Allure IV exhibited a greater range of values. Several authors have reported wider ranges of variation around mean values of bond strength for ceramic brackets than for metal brackets.[13,15,16] Ghafari, Skanchy and Mante suggested that debonding the tested ceramic brackets is still unpredictable.[14] They stated that mechanical retention, as presented in these brackets, did not reduce the shear force necessary for debonding, noting that further investigation was needed to determine whether the additional chemical retention incorporated in the Allure IV bracket was responsible for the increased level and range of forces. Finally, they suggested that increasing the resin space between the bracket base and the tooth through grooves or recesses might reduce the debonding force by favoring bond failure within the adhesive itself.

Reduce chemical adhesion.

Most manufacturers of ceramic brackets have eliminated chemical adhesion at the expense of exclusive mechanical retention, or still use silane coupling only as a reinforcement of mechanical retention. Guess and his co-workers[17] reported that silane coupling agents did not increase the force required for debonding brackets which had mechanical retention incorporated within their bases. However, Iwamoto[18] found that bond strength increased with silane coating as dehydration between hydroxyl groups of ceramic and silanol groups of silane molecules forms the strong Si-O-Ceramic bond. Iwamoto[18] also reported that as the mechanical retention incorporated in the base of the ceramic bracket increased, tensile and shear bond strength decreased and the failure rate at the bracket base\resin interface increased.

Table 1
Polycrystalline and monocrystalline commercial ceramic brackets and modes of retention

Polycrystalline brackets	Retention
Transcend 2000 (Unitek)	M2
Allure IV (GAC)	M2/C
Quasar(Rocky Mountain)*+	M2/C
Intrigue (Lancer)*	M2/C
Illusion (Ortho Organizers)*	M2C
20/20 (American Orthodontics)	C
Fascination (Dentaurum)	C
Lumina (Ormco)	M2
Eclipse (Masel)	M2/C
Polycrystal (OIS)+	M1/C
Contour (Class 1 Orthodontics)	M1/C
Monocrystalline brackets	
Starfire (A Company)	C
GEM (Ormco)+	M1/C

M=Mechanical retention
1 - Recesses or grooves;
2 - Fibrous, crusty or dimpled
C=Chemical retention
**indicates same bracket*
+indicates discontinued bracket

Despite the different findings in these studies, it seems that strong chemical adhesion is not necessary, regardless of the correct conclusion. The answer may indeed lie in (a) the form of mechanical retention needed to balance adequate bond strength with relative ease of debonding, and (b) whether partial selective silane coating is needed for adequate bond strength, particularly shear bond strength, which has been reported to be "always" greater than tensile bond strength for several combinations of ceramic brackets and bonding resins.[18] Proper investigations must be conducted to answer the following questions: do some forms of mechanical retention require reinforcement with silane coupling for optimal bond strength?; does the chemical reaction occurring with or without silane coating yield different bond strengths?

Add a metal mesh at the base of the bracket

A metal mesh at the base of the bracket would reduce bond strength to the levels observed with metal brackets. Adding the mesh, however, would mean an increase in production cost that is probably not acceptable at this time. It may also present an esthetic disadvantage.

Reduce the base area of the bracket

Reducing the bracket base area may decrease the bond strength but it does not eliminate high stress at the bond site.

Use weaker resins

Iwamoto[18] suggested that the composition of the resin influences the (tensile) strength of the bond. He reported that low-filled no-mix (System 1+, Ormco) and highly-filled (Clearfil SC Newbond, Kuraray) Bis-GMA resins used for bonding silane coated ceramic brackets led to higher percentages of bracket failure at the base/resin interface (80% and 90% respectively) or within the adhesive (20% and 10% respectively), than a 4 META/MMA-TBB unfilled resin (Superbond, Sun Medical) which yielded 40% failure within the bracket, 50% in the bracket/resin interface, and 10% within the resin. Comparatively, debonding metal brackets led to 100% failure within the highly-filled Bis-GMA resin while the low-filled, no-mix resin yielded 80% failure within the adhesive and 20% at the enamel/resin interface. The unfilled resin resulted in the following failures: 20% within the resin, 70% at the bracket/resin interface and 10% at the enamel/resin interface. Iwamoto also suggested that air bubbles which may develop with low- or highly-filled resins when bonding brackets with increased mechanical retention favors failure at the bracket/resin interface or within the bracket.

Joseph and Rossouw[12] reported a higher incidence of failure at the resin/bracket interface when original Transcend brackets (chemical retention) were bonded with light-activated, microfilled, more brittle composite resin (Heliosit Ortho, Vivadent AG) and increased failure within the enamel when the bracket was bonded with a chemically-cured, macrofilled, more elastic resin (Concise, Unitek/3M).

Storm[19] "found it more difficult" to debond ceramic brackets bonded with a heavily-filled resin (Concise, Unitek/3M) than those bonded with a hybrid-filled resin (Dynabond, 3M) which produced more failures at the bracket/resin interface. Nontheless, it seems that high- and low-filled resins have a clear practical advantage over unfilled composite adhesives. Swartz,[2] however, states that use of a no-mix or one-step bonding material with ceramics is probably contra-indicated. As the no-mix materials contain higher concentrations of amine accelatator for rapid setting, they tend to discolor more than those of a two-base mixture. Research of different resins used with different types of mechanically retained ceramic brackets should still be welcome.

Modify the thickness of the adhesive used

Evans and Powers[20] reported a decrease in tensile bond strength (30%) when the thickness of the cement (System 1+, Ormco) increased over 0.25mm. On this basis, Iwamoto[18] concluded that deep concavities in the bracket base are undesirable for this low-filled, no-mix resin. The basis for this statement was his observation that this resin did not undergo complete polymerization in deep bracket concavities (0.7mm), concurring with Swartz' observation that the polymerization shrinkage of no-mix systems could be too great for relatively large undercuts or indentations built into the mechanically retained ceramic brackets.[2] However, since the goal in improving ceramic brackets is establishing a balance between adequate bond strength and ease of debonding, it seems that mechanical retention favors an increase in thickness, albeit not uniform, between bracket base and tooth surface. Iwamoto's remarks[18] rather suggest that there is a threshold of efficacy or balance for mechanical retention, and that the interaction between depth of mechanically retentive areas (grooves/recesses versus fibrous/dimpled) and types of bonding resins (highly- versus low-filled) might affect optimal debonding forces. Such hypotheses must be tested through enlightened research.

Modify the etching time and/or concentration of etching acid (H_3PO_4)

Britton et al.[21] evaluated the in vitro retentive bond strength of four ceramic brackets bonded after etching times of 15 seconds and 60 seconds. The data suggested that the 15-second enamel etch increased both clinical predictability and bond strength when compared with a 60-second enamel etch. The Allure III bracket (GAC) exhibited high predictability and high bond strength regardless of enamel acid-etch time. Legler et al.[22] evaluated the effect of nine etching procedures on ground and unground enamel surfaces. They reported that the duration of etching significantly affected shear bond strength while H_3PO_4 concentration had no statistically significant different effect on shear bond strength. Unlike Britton et al.[21] they suggested that a reduction of the etch time to 15 seconds may result in greater bracket loss clinically. The difference in findings may be due to the fact that Legler et al. tested the bonding of a composite cylinder while Britton and co-workers used ceramic and metal brackets.

On the basis of clinical practice only, Carter[23] suggested an etching time of 30 seconds with ceramic brackets presented an acceptable balance between bond strength and ease of removal. Scientific exploration is still needed to establish whether an etching time of less than 60 seconds provides this balance with different types of ceramic brackets.

Solution D: Debond with ultrasonic, electrothermal and laser devices.

After testing three different debonding techniques on three types of ceramic brackets, Bishara and Trulove[24,25] reported that ultrasonic and electrothermal debonding resulted in lower incidences of bracket fracture, higher frequency of failure at the bracket/adhesive interface, and decreased chances of enamel damage. However, the ultrasonic technique required significantly increased debonding time (38 to 50 seconds), excessive wear of the expensive ultrasonic tips, the need to apply force levels possibly uncomfortable to patients with sensitive teeth, the potential for soft tissue injury, and the need for a water spray to avoid pulpal damage from heat build-up. Electrothermal debonding also includes this potential, as well as an increase in the temperature of the handpiece which can cause patient discomfort or mucosal irritation if not carefully used. Research is progressing on laser and electrothermal debonding instruments,[26,27] and the impact of these methods on short- and long-term pulpal response clearly must be determined.

Problem 2: Removal of ceramic brackets by grinding

When a proper debonding technique fails, and/or risks subjecting the tooth to increased forces and fracture, grinding the ceramic bracket becomes the option of choice. Grinding is usually conducted with high-speed diamond burs or low-speed green stones. The procedure is time-consuming and the heat which can be generated by grinding may affect the dental pulp and, subsequently, the vitality of the tooth.[28]

Solution: Reduce the size of ceramic to be ground by fracturing the tie wings with ligature cutting pliers, and avoid the build up of heat during grinding.

Air or water coolant must be used while grinding the bracket to avoid a rise in pulp chamber temperature.[28] In addition, the operator must avoid grinding the tooth enamel, particularly when water is the coolant.

Problem 3: Attrition of teeth occluding against ceramic brackets.

According to the AAO survey, this problem represents the highest percentage of injury from ceramic brackets.[7] It is due to the fact that ceramic brackets are harder than enamel.[29-31] Avoiding contact between porcelain and enamel has long been a standard procedure in prosthodontics. Several cases of attrition have been reported in the orthodontic literature.[31]

Solution: Select the teeth to be bonded with ceramic brackets.

The clinician must avoid bracket contact with opposing teeth. In a case with a deep anterior overbite, avoid bonding the mandibular teeth with ceramic brackets; in a case where the maxillary canine is retracted past the mandibular tooth, avoid bonding the mandibular canine.

Problem 4: Increased friction with ceramic brackets

The problem is due to the roughness of the bracket interface which slows the sliding of the archwire through the bracket.[32-36]

Solution A: Develop brackets with smoother slot surfaces

Brackets with smoother slot surfaces, incorporated metal slots — as in some plastic brackets — or brackets composed of ceramic and plastic may allow the archwire to slide smoothly.

Solution B: Avoid loss of anchorage and increase in overbite.

Strengthen the anchorage requirements and carefully select the teeth to be bonded. (See Conclusions 1.)

Problem 5: Breakage of ceramic brackets

This problem, which is due to the low fracture toughness of the aluminum oxide,[3,4,29,37] often affects bracket wings and usually occurs accidentally when cutting ligature wires or engaging a heavy archwire in the bracket. Sometimes the slightest torque of such wire in the bracket interface leads to fracture.[21] This side effect tends to occur in cases prepared for orthognathic surgery since archwires equal to the slot section are often used prior to surgery.

Solution: Avoid direct contact of the brackets when cutting ligature wires and forceful engagement of increasingly heavy archwires used for leveling

Successive archwires should be fully engaged in the brackets. Also, it may be safer to avoid using ceramic brackets in people prone to trauma because of professional or numerous sports activities, such as football, martial arts or other contact sports.

Problem 6: Increased pain or discomfort while debonding ceramic brackets

This is probably related to the higher bond strength.

Solution: Have patient bite with pressure on cotton roll and/or gauze during debonding

Reactions vary from patient to patient and in an individual, may even vary from tooth to tooth and with the timing of debonding. Indeed, pain may increase if the teeth being debonded have just undergone active movement or traumatic pressure from occlusion, elastics or other orthodontic forces.

Problem 7: Limited rotation of teeth with ceramic brackets

This problem mainly affects brackets designed for mandibular incisors because they are necessarily the smallest. Incorporating four wings tends to weaken the brackets. Ceramic brackets also tend to be bulkier than metal brackets as this is required for sufficient resistance to fracture.

Solution: Further research and development

Some companies already manufacture smaller brackets with four wings but additional research is needed to develop less bulky ceramic or ceramic-like materials which can provide the properties of metal brackets with the esthetic advantages of ceramics.

Problem 8: Different results in different areas

Solution: More controlled research

The major problem is in keeping up with the fast-paced design changes manufacturers have made in response to anecdotal reports of side effects. Ideally, developed products should be subjected to standardized clinical trials.

Manufacturers are continuously attempting to rectify deficiencies and "developmental crises"[32] with ceramic brackets. Independent researchers and clinicians try to keep up with testing the different modifications, supporting Kusy's statement that "competition and the demand by both patients and clinicians for less noticeable appliances have perhaps nurtured a somewhat premature product introduction."[32] He further notes that "this suspicion is fueled in part by the inconsistent supply of brackets in the marketplace..." Clearly, clinical guidelines must be established regarding the use of ceramic brackets to avoid the occurrence of present problems until the combined efforts of clinicians, researchers and manufacturers contribute to the development of better products.

In addition to the several issues reviewed in this paper, one of the questions which should be explored is whether the type of teeth and/or their preparation affects the outcome of debonding ceramic brackets. For example, the shear bond failure sites reported by Ghafari and Chen,[8] were in contradiction to those reported by Gwinnett[15] but in agreement with the findings of Viazis et al.[13] A possible explanation for the difference in results may be that teeth with curved and unprepared surfaces were used in the studies by Ghafari and Chen[8] (pairs of premolars from the same patients) and Viazis et al.[13] (premolars and canines) whereas incisors with surfaces ground flat and smooth composed the material in the Gwinnett[15] investigation.

Problem 9: Esthetic results are not absolute.

Although ceramic brackets hold a definite advantage over plastic attachments, some polycrystalline brackets do stain. This is probably due to individual diets — prolonged use of caffeine (coffee, tea, colas) for example, — or hygiene practices (certain mouthwashes), or lipstick, but may also be associated with the type of bonding resins used.[2]

Solution: Avoid excessive use of staining substances and, perhaps, select least-discoloring resins

Ceramic brackets may look discolored when the brackets themselves stain (direct discoloration) or when stains on the teeth or bonding resin show through the bracket (indirect discoloration). The problem warrants scientific exploration. It tends to occur with polycrystalline brackets which represent the majority of the ceramic brackets manufactured and so, are most commonly used. Using two-base resins, which tend to discolor less than no-mix one-step bonding resins, has been advocated by Swartz who also suggested the light-cured resins may offer "excellent color stability."[2] Viazis et al. reported the mean shear bond strength to be similar for a light-cured orthodontic adhesive (bonding paste plus enamel bond sealing resin; Transbond, Unitek/3M) and a conventional chemically cured system (two bonding pastes; Concise, Unitek/3M).[13] This problem may remain an individual occurrence but additional research is needed regarding the separate or combined effects of direct and indirect staining.

Problem 10: Operational risks

The primary operational risk for the patient is the accidental ingestion or aspiration of a bracket during bonding or debonding, or of bracket particles if the bracket fractures during debonding.[1] Because of their radiolucency, ceramic brackets may not be detected on radiographs if aspired. Also, during debonding, fractured fragments may subject the patient to oral soft tissue damage, and the patient, clinician and assistant to eye injury.

Solution: Use caution and protective equipment during bonding and debonding

Instructing the patient to bite on a cotton roll during debonding helps reduce the risk of dislodging brackets and/or fragments into the oral cavity and throat. The clinician and assistant should wear protective glasses and a mask. The patient should wear protective glasses as well, or at least keep both eyes shut.

Conclusions

The increasing volume of information about complications occuring with ceramic brackets and the associated litigation risk[38] leads to the following conclusions:

1. Ceramic brackets must be used selectively after careful evaluation of the individual malocclusion and orthodontic treatment plan. To combine the esthetic advantage of ceramics with careful avoidance of clinical complications, particularly tooth abrasion and increased friction, a conservative approach would limit bonding ceramic brackets to maxillary incisors and canines in nonextraction cases which do not require major distal movement of the canines, or to only the maxillary incisors in extraction cases or nonextraction cases which require significant distal movement of the canines and retraction of the incisors.

The principal reason for these guidelines lies in the increased friction of ceramic brackets attached to, and the ensuing difficulty in retracting the canines. This friction could lead to either or both of the following:

A.) Loss of posterior anchorage. If this occurs, posterior anchorage should be strengthened with, for example, a headgear, palatal bar, Nance holding arch, or other means. Retracting the canines separately before the incisors may help avoid or minimize anchorage loss. The incisors can then be moved using a wire bypassing the ceramic brackets of the canines which are tied back to the molars palatally (Figure 1).

B.) Increase in overbite by downward tipping of canines and incisors. In this instance, heavier wires and/or compensating moments should be used to resist the side effect. The increase in overbite may in itself lead to contact of maxillary teeth with (ceramic) brackets on opposing mandibular teeth, thus favoring attrition of the enamel of the maxillary teeth.

This side effect can occur in cases where an originally shallow or moderate overbite was perceived as an indication for using ceramic brackets on mandibular teeth. Therefore, ceramic brackets should be bonded on mandibular teeth only when contact between the brackets and opposing maxillary teeth, whether from tooth movement or parafunctional habits, is not anticipated at any time during treatment.

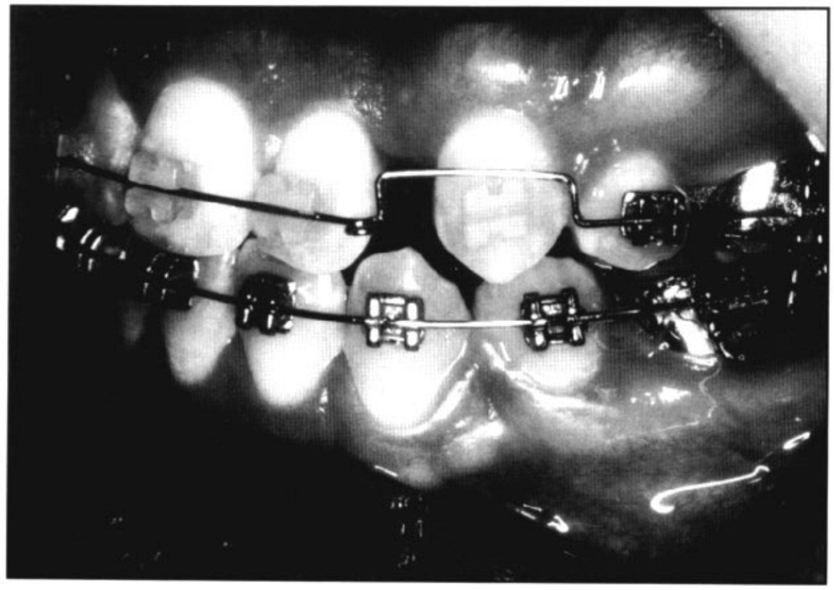

Figure 1

Figure 1
Archwire bypassing the canine to reduce friction as the incisors were retracted through elastics worn from the molars to helices bent distal to the lateral incisors. After retraction, the canines were held in place with a power chain to the molars palatally. Note the distal tipping of the canines. Light (Nitinol) wires were used subsequently to level and align.

2. The patient must be informed of the possible side effects associated with the use of ceramic brackets in general, and those particular to the treatment of the patient's malocclusion. Informed consent, such as that recommended by the American Association of Orthodontists (see above section on potential problems) should be used. Furthermore, all clinicians must be aware of potential hazards and clear contraindication to the use of ceramic brackets. This may be achieved through publications and communication from the AAO as well as the American Dental Association.

3. Critically- and scientifically-reviewed research of new products must precede commercialization and use. In other words, publication must precede publicity. For the individual patient, the risk may outweigh the esthetic — and only — benefit of ceramic brackets. Therefore, these brackets must be used selectively to fulfill the best interest of the patients. Close collaboration between commercial interests, the AAO and the orthodontic community should be pursued and guidelines for the use of ceramic brackets established following controlled trials.

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