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Conservative Treatment of the Worn Dentition with Adhesive Composite Resin

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2 CONTINUING EDUCATION CREDITS

COURSE OBJECTIVES

Upon completion of this course, the participant will be able to:

- Describe a treatment style for the anterior worn dentition when dentin is exposed and continuing to wear, including detailed instructions on tooth preparation, restoration placement, and finishing and polishing.
- Identify the cause of attrition due to bruxism, abrasion, and dietary erosion.
- Describe the number of treatment modalities available when excessive wear has been made.

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WHY TAKE THIS COURSE?

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Dentists, Dental Assistants, and Dental Hygienists.



Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

Fig. 1 Wear of the mandibular incisors into the dentin. **Fig. 2** Wear of the maxillary incisors into the dentin. **Fig. 3** Wear, due to bruxism, can contribute to shortening of the incisal edges of the maxillary incisors and chipping of the edges. **Fig. 4** Preoperative view of worn mandibular anterior teeth and premolars. **Fig. 5** Unsupported, chipped enamel finished using an abrasive disk.

As patients get older and keep their teeth longer, the wear of the incisal edges of anterior teeth has become more pervasive. Some have viewed tooth attrition as reaching epidemic proportions. In most cases, attrition of the mandibular incisors is viewed as loss of the enamel incisal edge, leaving the dentin exposed (Fig. 1). This is readily visible by the patient, especially when the dentin picks up stain. In the case of the maxillary incisors, the wear may not be readily apparent to the patient because it is on the lingual surfaces of the teeth (Fig. 2). But the wear may be evident due to chipping of the incisal edges (Fig. 3) and an increase in incisal translucency where the underlying enamel has worn thin.

Tooth attrition has been classified by Pinborg as:

- physiologic – the gradual and regular loss of tooth structure as a result of natural mastication
- pathologic wear confined to a single tooth or groups of teeth caused by abnormal function.
- the position of teeth.
- intensified attrition (wear) more extensive than would normally be expected.⁽¹⁾

One study reported 84.2% of 520 older adults had enamel attrition; 72.9% had dentin attrition; and 4.2% had severe attrition.⁽²⁾ Although tooth wear is usually associated with older adults, Schneider and Peterson reported 15% of children demonstrate tooth wear due to bruxism.⁽³⁾ Wear of the teeth may be caused by attrition due to bruxism, abrasion, and dietary erosion due to acid dissolution.⁽⁴⁻⁶⁾ In fact, wear of the occlusal surfaces has been characterized as a natural phenomenon with the continuing eruption of the posterior teeth to compensate for loss of tooth substance.^(7,8)

Since tooth wear is physical trauma to the teeth, pulpal changes occur to compensate for the loss of tooth structure.⁽⁹⁾ There is evidence of mineralization within the pulp chamber and root canal. Although the treatment of wear is mainly a restorative concern, in cases of severe attrition it has been reported that 11.6% of 448 patients had near pulpal exposures or frank pulpal exposures.⁽¹⁰⁾

In most clinical cases, tooth wear is not a single cause-and-effect condition. The wear may be caused by a combination of factors including attrition, abrasion, and erosion.⁽¹¹⁾ Mair has investigated the conditions of tooth wear. Rather than the dental classifications described in the past, Mair took the viewpoint of fundamental wear mechanisms.⁽¹²⁾ He has described these mechanisms as surface-to-surface wear, slurry wear (early stage), and corrosive wear (erosion). Surface-to-surface wear for teeth can be either enamel-to-enamel in contact movements with subsequent microfractures of the enamel structure; or the harder substance enamel plowing up the opposing softer dentin substrate. This mechanism of enamel wear is usually due to tooth grinding or bruxism.

Slurry wear can be characterized as an abrasive slurry between two moving tooth surfaces. It is also referred to as “three-body wear” be-



Fig. 6



Fig. 7



Fig. 8

Fig. 6 The enamel polished with a rubber abrasive point. **Fig. 7** Mandibular teeth after removing unsupported enamel and polishing. **Fig. 8** The teeth were prepared to a pulpal depth of 1.0 mm as evidenced by the cutting length of the #330 bur.

cause there are three surfaces in function – the tooth structure on the sides of the food substrate. Corrosive wear, also referred to as erosion, is a nonmicrobial acid-induced tooth loss. Clinically, the diagnosis of these conditions can be made by the appearance of the tooth surfaces in different occlusal positions. Surface-to-surface wear can be seen where the teeth interdigitate. Where slurry wear has occurred, the teeth do not fit together in all aspects of the tooth loss. This concept has been frequently referred to as erosion.⁽¹³⁾ The cupping of dentin on incisal edges and the flattening of posterior cusp tips with the exposing dentin, the Class 6 lesion, can be attributed to this type of wear. Corrosive wear from acids can be caused by ingesting acidic foods and beverages or by stomach acid attacking the teeth as a result of bulimia or stomach acid reflux. In these cases, the evidence of corrosive wear is diagnosed by the presence of restorations protruding above the occlusal plane of the tooth structure. In recent years, there has been more information with the adolescent population and chemical erosion of tooth substrate due to ingestion of acidic beverages.^(14,15) Acid reflux from gastrointestinal reflux disease (GIRD) can also be a major contributor to corrosive wear.^(16,17) In actuality, the diagnosis of tooth wear is multifactorial in most cases.

Although tooth wear has been associated with the older dentition, young adults are also demonstrating tooth wear. Pintado and others measured attrition in 18 dental students between the ages of 22 and 30 years old. They found that there was an average tooth loss of 10.7 micrometers after one year, and these numbers almost doubled after two years.⁽¹⁸⁾ Xhonga et al.,⁽¹³⁾ Molnar et al.,⁽¹⁹⁾ and Lambrechts et al.⁽²⁰⁾ found similar results of almost 50 micrometers of wear over one year. While tooth wear is typically as-

sociated with bruxism, with the clinical recommendation to have an oral appliance placed to minimize tooth structure loss from grinding, the diagnosis of erosion should not be ruled out. Khan and coworkers analyzed 104 patients in Queensland, Australia, with excessive tooth wear from either erosion or attrition due to bruxism.⁽²¹⁾ Using a questionnaire, and analyzing the type of wear present by scanning electron microscopic criteria, they compared the incidence of attrition among three groups – bruxers, possible bruxers, and nonbruxers. Their findings indicated erosion was predominant in all sextants of the three groups to the virtual exclusion of attrition in the molar sextants. Even bruxers demonstrated more erosion. The only sextant with more changes due to attrition was the mandibular anterior area. It is possible from their data that attrition may be an initial cause of tooth loss. But when the wear is severe with exposed dentin, erosion becomes a more important factor in the progression of the wear phenomenon. Early, subtle tooth changes can go unrecognized or be “watched” and re-evaluated during recall examinations until the severity of wear requires a restorative intervention. Less severe anterior wear can be treated with adhesive composite resin restorations.

^(22,23) When the diagnosis of excessive wear is made, a number of treatment modalities are available. Bonded porcelain veneers have been used to treat incisal wear.⁽²⁴⁾ Adhesive cast metal restorations have also been used to replace missing tooth structure.^(25,26) In cases where the occlusion is decimated by attrition, the only treatment choice may be a reconstruction with crown and bridge.⁽²⁷⁻²⁹⁾ In the case of anterior wear patterns, the loss of enamel at the incisal edge can lead to exposure of the dentin and the continuing loss of tooth structure due to slurry wear. Cook demonstrated progressive wear of front teeth using crayons.⁽³⁰⁾ The tip of the crayon has a narrow diam-



Fig. 9 Completed preparations. **Fig. 10** The preparations were etched with a 32% phosphoric acid gel for 15 seconds. **Fig. 11** A fifth-generation adhesive was applied to the etched tooth preparations. **Fig. 12** Care was taken to shape the composite resin with a plastic-filling instrument to minimize excess. **Fig. 13:** Initial finishing was done with an Enhance polishing disk.

eter. As it is used, the crayon diameter becomes larger, similar to the phenomenon seen with anterior tooth wear. He found that this technique educated the patient about the presence of wear and the need for treatment intervention.

How does one treat the anterior worn dentition when dentin is exposed and continuing to wear? In some cases, the patient notices the discoloration of the incisal edges of their mandibular teeth due to exposed dentin and inquires about it. Other times, the patient notices a bluish translucency at the incisal edges on the facial surfaces of the maxillary incisors. It is caused by the worn dentin on the lingual surfaces of these teeth, leaving just translucent enamel. In some cases, the incisal edges can be restored to the existing vertical dimension with direct composite resin^(22,31). Hemmings and coworkers reported on the clinical results of restoring severe anterior wear and increasing the occlusal vertical dimension.⁽³²⁾ They reported an 89.4% success at 30 months. When composite resin is used to restore the lost tooth structure in the anterior region, it is important to pay special attention to the principles of occlusion, combined with the use of occlusal appliances, to minimize the future wear that will occur.⁽²³⁾ This article will describe a conservative treatment of the worn anterior dentition using direct bonded, wear-resistant composite resin.

CASE #1

A 53-year-old man presented to the dental school clinic requesting treatment for his dental needs. As part of the treatment review, the patient asked if anything could be done for his lower front teeth. They were chipped and discolored on the incisal edges due to exposed dentin. (Fig. 4) It was noted during the examination the maxillary incisors and canines had some wear but did not require any intervention because the enamel was still intact. After restorative treatment, the plan was to provide the patient with a hard acrylic occlusal nightguard to control the patient's parafunctional habit of bruxing. The diagnosis of anterior tooth wear through the enamel into the dentin with a cupped-out appearance indicative of a combined surface-to-surface and slurry tooth-wear pattern was made. The restorative treatment plan for these teeth was the placement of direct bonded composite resin to restore the worn incisal edges and cusp tips of teeth #21-28.

In the past, use of composite resin to restore worn anterior teeth was not successful because the practitioner did little tooth preparation to retain the restoration. The teeth would be lightly beveled, the dentin roughened with a bur with no definitive preparation, and an adhesive composite resin placed in a thickness of only tenths of a millimeter. Within a short period of time, the restoration would be dislodged in function.⁽³¹⁾ Success with these restorations depends on a fundamental approach to tooth preparation to guarantee durability of the restoration.⁽²²⁾

In most cases, the teeth to be restored do not need to be anesthetized. The exposed dentin is sclerotic and has little, if any, sensation.

OUT ALONG DOTTED LINE

Use of the dental dam for tooth isolation allows the teeth to be prepared and restored with greater efficiency and with a controlled field for the adhesive procedure. Because of the tooth wear, the proximal contacts are usually broader and there is little, if any, incisal embrasure. It may be necessary to re-create the incisal embrasures using a narrow-diameter, needle-shaped finishing bur (ET3 fine, Brasseler USA, Savannah, GA). If this is not done at the start, it will be difficult to place the rubber dam. For this patient, the presence of slight tooth mobility allowed for the placement of the rubber dam without the need to reshape the incisal embrasures. The rubber dam was placed to include all teeth from #20 to #29

TOOTH PREPARATION

Before the tooth preparations, the enamel surfaces were finished and polished to remove unsupported enamel using an abrasive disk system (Soflex, 3M-ESPE, Minneapolis, MN) (Fig. 5) from medium grit to fine, and a final polish of the enamel was done with an intraoral, rubber-abrasive, enamel-ceramic polishing point (Dialite, Brasseler USA, Savannah, GA) (Fig. 6). The finishing and polishing of the enamel surface removes any irregularities of the enamel and loose enamel rods that can fracture after the completion of the restoration. (Fig. 7)

Using a small, pear-shaped 330 bur, a preparation was made into the dentin to a depth of 1.0 mm. (Fig. 8) For smaller-sized lesions, a 329 bur can be used because it has a length of 1.0 mm, which is the preparation depth desired. A periodontal probe can also be used to verify the pulpal depth of 1.0 mm of the tooth preparation of all enamel walls. Past clinical experiences and evaluations over the last 10 years has shown this depth into the dentin allows adequate composite resin thickness to provide longevity to the restoration in function. The preparation removes only dentin, leaving a shell of enamel. For this patient, the enamel was thin in some areas and there was enamel chipping on the facial surfaces of some teeth. (Fig. 9) This is not a problem because the composite resin will restore that surface.

RESTORATION PLACEMENT

After tooth preparation, the teeth were etched for 15 seconds with a 32% phosphoric acid etchant (Uni-Etch, Bisco, Schaumburg, IL) (Fig. 10) and then rinsed with an air-water spray for 10 seconds. The tooth was lightly dried, leaving a moist dentin surface. A single component, fifth-generation adhesive (One-Step, Bisco, Schaumburg, IL) was applied to the tooth preparation with a disposable brush (BendaBrush, Centrix, Shelton, CT). (Fig. 11) The adhesive was gently air-dried, keeping the air syringe 4-6 inches from the surface of the tooth so the adhesive was not thinned before light curing. The adhesive was light-cured for 20 seconds. A wear-resistant, hybrid composite resin (TPH, Dentsply/Caulk, Milford, DE) was placed into the incisal preparations. The composite resin was shaped to the tooth surfaces using a plastic filling instrument (AB1 PFI, Hu-Friedy, Chicago, IL) so there was little excess needing to be finished (Fig. 12). The composite resin was then light-cured for 20 seconds for each tooth.



Fig. 14 Final polish was accomplished with a superfine Soflex polishing disk. **Fig. 15** Occlusion is adjusted and verified with ultrathin articulating film. **Fig. 16** The completed restorations are functional and esthetic. **Fig. 17** At seven years, the restorations are functioning well. **Fig. 18A** A study cast can demonstrate the degree of wear present.



Fig. 18 B The study cast appearance correlates to the clinical degree of incisal and lingual wear present. **Fig. 19** When preparing the areas of worn dentin, orient the bur to be at right angles to the surfaces being prepared. **Fig. 20** Preparations completed.

FINISHING AND POLISHING

The composite resin placement, as described, leaves very little excess. In most cases, an abrasive-backed disk is not necessary. The finishing can be accomplished using an aluminum oxide impregnated silicone disk (Enhance, Dentsply/Caulk, Milford, DE) (Fig. 13). The final polish was done using a superfine Soflex disk (3M, St. Paul, MN). (Fig. 14) The rubber dam was removed, and all occlusal movements were checked using a very thin, two-sided occlusal film (AccuFilm II, Parkell, Farmingdale, NY). (Fig. 15) It should be noted: the composite resin restores function to areas the wear had removed function. In this case, note the facial surfaces of the mandibular right and left canines. They have been restored to function in lateral excursions to protect the dentition with canine disclusion. A hard, acrylic, maxillary occlusal nightguard was fabricated to protect the dentition from parafunctional wear. The restored incisal edges have not only made the teeth more wear resistant, but also have created a more esthetic result. (Fig. 16) After seven years, the restorations are functioning well and have minimized tooth destruction due to wear. (Fig. 17)

CASE #2

Although the wear of mandibular incisors is most obvious to the patient, the penetration into the dentin of maxillary anterior teeth is also a frequent occurrence. Since these areas are more difficult to visualize, it may be necessary to demonstrate the degree of wear to the patient by showing them a cast of their teeth. In some cases, the patient has a chief complaint of discoloration of maxillary incisor facial surfaces – due to wear of the lingual surfaces – leaving a thin enamel shell with excessive incisal translucency. A 63-year-old male patient complained of discolor-

ation due to excessive incisal translucency. With the use of a cast, (Fig. 18A) the patient was shown the degree of wear that had occurred to lingual surfaces of his maxillary anterior teeth. The clinical appearance of these teeth demonstrated moderate wear of the maxillary incisors and canines (Fig. 18B).

The teeth were isolated with a rubber dam. As described previously, the unsupported and chipped enamel were polished with finishing disks and rubber abrasives before tooth preparation.

TOOTH PREPARATION

The teeth were prepared using a #330 pear-shaped bur to a depth of 1.0 mm. To maintain a constant preparation depth, the bur was held at right angles to the surfaces being prepared. (Fig. 19) When preparing the lingual surfaces of the maxillary incisors and canines, angle the bur so the cavosurface margins are at right angles to the tooth surface. This will provide for a bulk of composite resin that will wear and fracture. It is important, in the shallowest areas of tooth preparation, a depth of 1.0 mm be attained. (Fig. 20)

TOOTH RESTORATION

The teeth were etched for 15 seconds with a phosphoric acid etchant. A single component, fifth-generation adhesive (Single Bond, 3M-ESPE, Minneapolis, MN) was applied using a disposable BendaBrush (Fig. 21) and light-cured for 10 seconds. A wear-resistant, nanohybrid composite resin (Filtek Supreme Plus, 3M-ESPE, Minneapolis, MN) was placed into the cavity preparations, adapted with a hand instrument (Fig. 22), and light cured for 20 seconds. Finishing, verification of occlusion, and polishing were accomplished as previously described. The result eliminated incisal translucency

OUT ALONG DOTTED LINE



Fig. 21 A fifth-generation adhesive was applied and light cured for 20 seconds. **Fig. 22** Adapting the composite resin to the cavity preparations. **Fig. 23** Restoration of the lingual surfaces of the maxillary incisors and canines.

and restored the lingual surfaces of the maxillary anterior teeth. (Fig. 23)

CONCLUSION

In the past, practitioners would watch and re-evaluate worn incisal edges of anterior teeth as they continued to wear. Intervention would occur when

the crown height was significantly reduced and the only choice to restore these teeth was full-coverage, porcelain-metal crowns. With the conservative technique described, a wear-resistant composite resin to maintain the occlusion on these anterior tooth surfaces can be placed to defer the need for more extensive crown and bridge procedures in the future.

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1. **Tooth attrition refers to:**
 - a. notching of the cervical areas of teeth
 - b. acid erosion of the teeth on the facial and lingual surfaces
 - c. loss of tooth structure as a result of natural mastication or pathologic wear
 - d. an increase in tooth mobility due to bone loss

2. **According to this article, wear of occlusal surfaces of teeth by attrition can be caused by all the following EXCEPT. The EXCEPTION is:**
 - a. bruxism
 - b. abrasion
 - c. dietary erosion due to acid dissolution
 - d. recalcification

3. **A reference in this article from Mair has described the fundamental tooth wear mechanisms. These mechanisms have been described as:**
 - a. bacteria acid dissolution with demineralization and remineralization
 - b. disarticulative enamel fracture with dentin dissolution
 - c. Surface-to-surface wear, slurry wear (early stage) and corrosive wear (erosion)

4. **It is not unusual to see occlusal or incisal wear where the tooth surfaces do not fit together in all aspects of tooth loss. While the enamel may contact, the dentin on cusp tips and incisal edges is cupped out and not in contact. This is due to:**
 - a. slurry wear occurring with consequent erosion
 - b. ceramic crowns against tooth surfaces
 - c. metal crowns against tooth surfaces
 - d. eating foods that created microcracks in the enamel leading to enamel loss

5. **Corrosive wear of teeth is characterized by the presence of restorations protruding about the occlusal plane of the tooth structure. This can be caused by:**
 - a. inadequate fluoride during tooth development
 - b. attack of the tooth by ingesting acidic foods and beverages or by stomach acid attacking the teeth as a result of bulimia or stomach acid reflux
 - c. the patient using bleaching agents for a long period of time
 - d. the patient using a hard-bristled tooth brush

6. **Tooth wear is only associated with older patients. Younger adults do not demonstrate tooth wear.**
 - a. both statements are true
 - b. the first statement is true, the second statement is false
 - c. both statements are false
 - d. the first statement is false, the second statement is true

7. **In a reference cited in this article, a research study in Queensland, Australia, investigated 104 patients with excessive tooth wear from erosion or attrition due to bruxism. They classified their data dependent on three groups – bruxers, possible bruxers, and nonbruxers. According to their evaluation:**
 - a. only bruxers and possible bruxers demonstrate tooth wear
 - b. erosion predominated in all sextants of all three groups to the virtual exclusion of attrition in the molar sextants
 - c. hard-acrylic nightguards prevent tooth wear for the bruxer group
 - d. hard-acrylic nightguards prevent tooth wear for the non-bruxer group

8. **When the diagnosis of excessive wear is made, the treatment available:**
 - a. is adhesive cast restorations
 - b. is bonded porcelain veneer
 - c. reconstruction with crown and bridge
 - d. all the above treatment modalities can be used for treatment

9. **In this article, when minor tooth attrition on the incisal edges of mandibular incisors is evident with the presence of exposed dentin, a conservative restorative treatment choice to reduce continuing attrition is:**
 - a. at-home tray bleaching
 - b. fluoride treatment in disposable trays
 - c. wear resistant composite resin restorations
 - d. $\frac{3}{4}$ porcelain-metal crowns

10. **Preparing the worn anterior teeth with facial and lingual beveling and roughening of the dentin with a bur to restore the worn incisal edges will usually lead to:**
 - a. premature fracture and loss of the composite resin restoration
 - b. increased dentin hypersensitivity
 - c. improvement in tooth shade

- CUT ALONG DOTTED LINE
11. **When using adhesive composite resins to restore maxillary and mandibular incisors that demonstrate wear through the enamel just barely into dentin, the tooth preparations are made with:**
 - a. a medium-grit, flame-shaped diamond
 - b. a 556 crosscut fissure bur
 - c. either a 329 or 330 pear-shaped bur
 - d. a #6 round bur

 12. **The minimum depth for the preparation of worn incisors that is recommended in this article is:**
 - a. 0.5 mm
 - b. 1.0 mm
 - c. 2.0 mm
 - d. 3.0 mm

 13. **The tooth preparation described in this article removes the exposed dentin to a specific depth of preparation leaving a shell of enamel. There will be times the enamel may chip on the facial surface. When the enamel chips on the facial surface, this article's technique recommends:**
 - a. change the treatment plan to a porcelain veneer
 - b. change the treatment plan to a full-coverage crown
 - c. to continue using the conservative adhesive composite resin technique
 - d. change the treatment plan to a glass ionomer restoration to prevent recurrent caries at the margins

 14. **The restorative procedure described in this article uses:**
 - a. an etch-and-rinse adhesive with composite resin
 - b. a resin modified glass-ionomer
 - c. dental silver amalgam
 - d. a self-etching adhesive and packable composite

 15. **To help reduce continuing tooth wear for the first case presented, the patient:**
 - a. was assessed with a myomonitor occlusion device
 - b. was assessed with a T-Scan occlusion device
 - c. had the occlusion restored on the posterior teeth to open up the bite to avoid continuing wear of the incisors
 - d. had a hard acrylic maxillary occlusal guard fabricated

 16. **There will be times the patient observes wear of the maxillary anterior teeth as evidenced by the presence of:**
 - a. increased incisal translucency on the facial surfaces
 - b. fractures on the cervical aspects of the canines
 - c. craze lines on the facial surfaces of the maxillary canines
 - d. discolorations on the proximal surfaces of the maxillary incisors

 17. **The etching time recommended in this article when restoring the worn dentition with adhesive composite resin is:**
 - a. 15 seconds
 - b. 30 seconds
 - c. 60 seconds
 - d. 90 seconds.

 18. **After the restoration has been placed and the dental dam removed, it is important to:**
 - a. check and adjust the occlusion
 - b. polish the enamel surfaces to avoid marginal staining of the composite resin
 - c. coat the composite with a sealant to improve wear resistance

 19. **One technique described in this article to demonstrate the degree of wear on the maxillary anterior teeth is to:**
 - a. blow air on the teeth to demonstrate increased sensitivity
 - b. make a maxillary cast and show the patient a comparison between a normal dentition with no wear and their dentition that has anterior wear
 - c. do a bite registration and show the patient how they have bitten through the registration material
 - d. mark the teeth with articulating ribbon to demonstrate the degree of wear

 20. **In the conclusion of this article, the rationale for using a conservative technique with adhesive composite resin is:**
 - a. to improve patient comfort
 - b. to maintain occlusion on the anterior teeth and defer the need for more extensive crown and bridge procedures in the future
 - c. to justify the use of tooth whitening once the composites are completed
 - d. eliminate the need for a hard acrylic resin occlusal guard

ANSWER KEY

1. (A) (B) (C) (D)
2. (A) (B) (C) (D)
3. (A) (B) (C)
4. (A) (B) (C) (D)
5. (A) (B) (C) (D)
6. (A) (B) (C) (D)
7. (A) (B) (C) (D)
8. (A) (B) (C) (D)
9. (A) (B) (C) (D)
10. (A) (B) (C)
11. (A) (B) (C) (D)
12. (A) (B) (C) (D)
13. (A) (B) (C) (D)
14. (A) (B) (C) (D)
15. (A) (B) (C) (D)
16. (A) (B) (C) (D)
17. (A) (B) (C) (D)
18. (A) (B) (C)
19. (A) (B) (C) (D)
20. (A) (B) (C) (D)

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