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REMINERALIZACIJA DEMINERALIZOVANE GLEĐI OKO ORTODONTSKIH BRAVICA

REMINERALIZATION OF DEMINERALIZED ENAMEL AROUND ORTHODONTIC BRACES

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Apstrakt

Uvod. *Pojava dekalcifikacije na zubima oko bravica ortodontskih aparata može se redukovati adekvatnom oralnom higijenom i upotrebom florida.*
Cilj *ove studije bio je da se skening elektronskom mikroskopijom ispitaju ultrastrukturne promene na površini gleđi nakon tretiranja uzoraka različitim preparatima sa fluoridima.*
Materijal i metode. *Na 30 zubnih uzoraka (premolara), ekstrahiranih iz ortodontskih razloga, postavljene su ortodontske bravice i fiksirane Fuji Ortho LC. Zubi su podeljeni u tri grupe po 10 zuba. Prva grupa bila je kontrolna, bez tretiranja rastvorima fluorida. Druga grupa uključivala je zubne uzorke koji su bili tretirani Fluorogal-om (0,05% F), svakog dana po 1 minut u periodu od 6 meseci; treća grupa uključivala je zubne uzorke koji su bili tretirani GC Tooth Mousse-om svakog dana po 5 minuta u periodu od 6 meseci. Zubi su stavljeni u veštačku pljuvačku u periodu od 6 meseci. Nakon toga, uzorci su tehnikom spaterovanja u vacum evaporatoru pripremljeni za skening elektronsku mikroskopiju, SEM (JEOL JSM 5300). Analizirana je površina gleđi kako bi se utvrdile mikromorfološke promene u strukturi na mestima prethodne fiksacije bravice.*
Rezultati. *Dobijeni rezultati pokazuju da je SEM-analizom utvrđen najveći remineralizacioni potencijal na zubnim uzorcima koji su svakodnevno izlagani malim dozama fluorida.*
Zaključak. *Remineralizacija demineralizovane gleđi je prisutna u obe eksperimentalne grupe zuba, ali je bila izraženija u grupi zuba tretiranih rastvorom Fluorogala.*

Ključne reči: *gleđ, bravica, demineralizacija, remineralizacija.*

Abstract

Introduction. *Decaltification on the teeth around the orthodontic braces can be reduced with adequate oral hygiene and use of fluorides.*
Aim. *The aim of this study was to examine, using scanning electron microscopy, the ultrastructural changes on enamel surface after the treatment with different fluoride preparations.*
Methods. *Orthodontic braces were placed on 30 dental samples (premolars) extracted for orthodontic reasons and orthodontic braces fixed with Fuji Ortho LC. The teeth were divided into three groups with 10 teeth each. First group was the control one, without treatment with fluoride solutions. Second group consisted of teeth samples treated with Fluorogal (0.05% F), every day for 1 minute in the period of 6 months. Third group consisted of teeth samples treated 5 minutes daily with GC Tooth Mousse in the period of 6 months. The teeth were placed in artificial saliva in the period of 6 months. Afterwards, the samples were prepared for scanning electron microscopy, SEM (JEOL JSM 5300) using the technique of sputtering in a vacuum evaporator. Enamel surface was analyzed in order to identify micromorphologic structural changes on the places where braces had been previously fixated.*
Results. *The results indicated that SEM analysis detected the highest remineralization potential in the tooth samples exposed daily to low doses of fluoride.*
Conclusion. *Remineralization of demineralized enamel was present in both experimental groups of teeth, being more intense in the group treated with Fluorogal solution.*

Key words: *enamel, brace, demineralization, remineralization*

Uvod

Veliki broj pacijenata svoje probleme, funkcionalne i estetske prirode, rešava ortodonts-

Introduction

Many patients resolve their functional and esthetic dental problems with orthodontic treat-

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kim tretmanom. Ortodontski aparati (fiksni ili mobilni) pogodni su za akumulaciju dentalnog plaka, zato što se kariogene bakterije uglavnom akumuliraju na teško dostupnim površinama. Tako, sa povećanjem broja kariogenih bakterija povećava se i opasnost od karijesa u toku ortodontske terapije fiksnim aparatima[1,2]. Dekalcifikacija zuba oko bravica kod pacijenata sa ortodotskim aparatima može se zaustaviti kontinuiranom upotrebom dentalnog krema GC Tooth Mousse u toku ortodontskog tretmana[3].

GC Tooth Mousse je dentalni krem na bazi vode, bez šećera, koji sadrži jedinjenje RECALDENT™ CPP-ACP, a proizvod je prirodnog proteina kazeina koji potiče iz mleka. Ovaj protein deluje na dva načina: sa jedne strane predstavlja izvor jona kalcijuma i fosfata, a sa druge omogućava transport ova dva esencijalna minerala do zubnih površina[4,5].

Rezultati grupe autora[6,7], koji su ispitivali nastanak karijesa unošenjem CPP-ACP jedinjenja, pokazuju redukciju karijesa kada se ovo jedinjenje unosi u obliku gume za žvakanje. Gume za žvakanje su idealno sredstvo za transport CPP-ACP jedinjenja u ustima, pošto na takav način ostaje u ustima dovoljno dugo i pokazuje svoj korisni efekat. Potvrđeno je njegovo prisustvo u plaku do tri časa nakon prestanka žvakanja gume[8,9].

Pojava dekalcifikacije na zubima oko bravica ortodontskih aparata može se redukovati adekvatnom oralnom higijenom i upotrebom fluorida. Istraživanja Artuna sa sar.[10] ukazala su da kod pacijenata sa ortodontskim aparatom oralna higijena ima veliku ulogu u redukciji dekalcifikacije gleđi. Takođe, terapija fluoridima utiče na redukciju demineralizaciije gleđi i sprečava aktivnost plaka blokiranjem bakterijskog enzimskog sistema.

Geiger i sar.[11] su pratili efekat fluorida na formiranje bele mrlje kod pacijenata sa fiksnim ortodontskim aparatima. Posle fiksiranja bravica na zube, pacijentima je preporučeno svakodnevno korišćenje 0,05% rastvora NaF za ispiranje usta pre spavanja. Od 101 pacijenta trećina je imala formiranu belu mrlju na jednom ili više zuba. Autori su zaključili da pojedinačna lokalna aplikacija fluorida neposredno nakon fiksacije aparata nema neke koristi, ali da pacijenti treba svakodnevno da koriste rastvore za ispiranje usta sa fluoridima sve vreme dok nose fiksni ortodontski aparat.

ment. Orthodontic devices (fixed or mobile) are liable to the accumulation of dental plaque since cariogenic bacteria commonly accumulate on hardly accessible areas. With increasing numbers of cariogenic bacteria during the orthodontic treatment with fixed devices, the risk of caries is increasing as well[1,2]. Tooth decalcification around the brace in patients with orthodontic devices can be checked by way of continual use of dental cream GC Tooth Mousse during an orthodontic treatment[3].

GC Tooth Mousse is a dental cream based on water, without sugar, containing the compound termed RECALDENT™ CPP-ACP, being the product of a naturally occurring protein casein derived from milk. This protein acts in two ways: on the one hand it is the source of calcium and phosphate ions, and on the other hand it enables the transport of these two essential minerals to dental surfaces[4,5].

The results of a group of authors[6,7] examining the occurrence of caries after the intake of CPP-ACP compounds have demonstrated caries reduction when the compound was contained in a chewing gum. Chewing gums are an ideal vehicle for CPP-ACP compound trasport in the mouth, since it remains in the mouth long enough and is able to exert its beneficial effects. Its presence in the plaque has been confirmed even up to three hours after gum chewing[8,9].

Decalcification on the teeth around the orthodontic braces can be reduced with adequate oral hygiene and use of fluorides. The investigations of Artun et al.[10] have shown that in patients with orthodontic devices oral hygiene has an important place in the reduction of enamel decalcification. Moreover, fluoride treatments have an impact on the reduction of enamel demineralization, preventing plaque activity blocking the bacterial enzyme system.

Geiger et al.[11] have monitored the effect of fluorides on the formation of white spots in patients with fixed orthodontic devices. After the fixation of braces, the patients were instructed to use daily a 0.05% solution of NaF as a mouth rinse before going to bed. Out of 101 patients, one third had white spots formed on one or more teeth. The authors concluded that individual topical fluoride application immediately after the device fixation was not particularly beneficial. However, the patients should use daily the fluoride-based solutions for mouth

Veoma efikasno sredstvo za lokalnu aplikaciju koje obezbeđuje visok nivo fluora u oralnoj sredini su lakovi sa fluoridima. Lakovi sa fluoridima se koriste sa ciljem da se fluoridi što duže zadrže na površini gleđi, kako bi se što više inkorporirali u latice kristala gleđi. Primena Fluor Protektor-a/Vivadent pre cementiranja ortodontskih prstenova sa glas jonomerom smanjuje nastanak početne kariozne lezije – bele mrlje[12].

Maijer sa sar.[13] u svojim istraživanjima pokazuje da je dekalcifikacija ispod ortodontskih prstenova cementiranih glas jonomerom manja, nasuprot cink fosfatnom cementu. Cink fosfatni cement se u oralnoj sredini rastvara mnogo lakše od glas jonomer cementa i vodi do stvaranje pukotina[14].

Materijali koji se upotrebljavljaju u ortodonskoj praksi su materijali za lepljenje bravica i cementiranje prstenova. Dodirna površina između zuba i materijala za lepljenje predstavlja osetljivu oblast. Osnova adhezije u ortodontskoj terapiji fiksnim aparatima ogleda se u prethodnom predtretmanu površine gleđi zuba kiselinom, pri čemu dolazi do stvaranja mikropukotina, koje predstavjaju retenciona mesta za kasniju aplikaciju bonda, tj. adhezivnog materijala[15,16].

Proizvođači novog sistema samonagrizajućeg osnovnog premaza smatraju da adekvatna jačina vezivanja može biti postignuta bondiranjem ortodontskih bravica za vlažnu površinu gleđi zuba. Najispitivanji adhezivni materijali su glas-jonomer cementi (GJC) koji imaju određene prednosti. Bondiraju se direktno na površinu gleđi zuba bez prethodnog nagrizanja, pri čemu dolazi do interakcije jona poliakrilata sa Ca iz hidroksiapatita. Glas jonomer cementi, pored toga, poseduju i kariostatski efekat otpuštajući jone fluora[17].

Fricker[18] je koristeći glas jonomer cement kao adhezivni materijal u procesu bondiranja ortodontskih bravica ispitivao proces demineralizacije (bela mrlja) koji nastaje u predtretmanu i proces remineralizacije, kao rezultat dejstva fluorida iz navedenog adhezivnog materijala. Nakon opservacijskog perioda od 12 meseci, rezultati su pokazali signifikantnu redukciju demineralizovane gleđi u grupi ispitivanih uzoraka sa glas jonomer cementom po debondiranju bravica.

rinsing all the time while they are wearing fixed orthodontic devices.

Very effective agents for local application, providing a high level of fluor in the oral environment, are fluoride varnishes. Fluoride varnishes are used in order for fluorides to remain on the enamel surface as long as possible, to be incorporated in the enamel crystal lattices as much as possible. The use of Fluor Protector/ Vivadent before cementing of orthodontic rings with a glass ionomer, suppresses the occurrence of the initial carious lesion – the white spot[12].

Maijer et al.[13] in their investigation have shown that decalcification under the orthodontic rings cemented with glass ionomer is less pronounced compared to zinc-phosphate cement. Zinc-phosphate cement is more easily dissolved in the oral environment compared to glass ionomer cement, leading to the formation of cracks[14].

The materials used in orthodontic practice are the materials for brace gluing and for cementing the rings. The interface between the teeth and gluing material is a sensitive area. The basis of adhesion in orthodontic therapy with fixed devices is contained in the pre-treatment of the tooth enamel surface with acid, thus creating the microcracks i.e. the retention surfaces for subsequent application of a bond – an adhesive material[15,16].

The manufacturers of a new system of self-etching basic coat believe that an adequate bonding strength can be achieved by way of bonding orthodontic braces to the wet tooth enamel surface. Some of the most extensively studied adhesives are glass-ionomer cements (GJCs), with some well described advantages. They are bonded directly to the tooth enamel surface, without previous etching, with an interaction of polyacrylate ions with hydroxyapatite calcium. Glass-ionomer cements exert, in addition, a cariostatic effect by way of releasing the ions of fluor[17].

Using the glass-ionomer cement as an adhesive for orthodontic brace bonding, Fricker has studied the process of demineralization (white spots) occurring in the pre-treatment period and process of remineralization as the result of fluoride action from the adhesive material[18]. After the observation period of 12 months, the results demonstrated a significant reduction of demineralized enamel in the group of studied samples with glass-ionomer cement after brace debonding.

Cilj

Cilj ove *in vitro* eksperimentalne studije bio je da se skening elektronskom mikroskopijom (SEM) ispitaju ultrastrukturne promene na površini gleđi nakon tretiranja uzoraka različitim preparatima sa fluoridima.

Materijal i metode

Ispitivanjem je obuhvaćeno 30 premolara, ekstrahiranih iz ortodontskih razloga. Nakon kondicioniranja zuba GC Condicioner-om, fiksirane su bravice glas-jonomer cementom (Fuji Ortho LC).

Svi zubi podeljeni su u tri grupe:

- I grupa zuba - kontrolna, bez tretiranja rastvorima fluorida;
- II grupa zuba – uključivala je zubne uzorke koji su bili tretirani rastvorom Fluorogala (0,05% F), svakog dana po 1 minut u periodu od 6 meseci;
- III grupa zuba - uključivala je zubne uzorke koji su bili tretirani GC Tooth Mousse-om svakog dana po 5 minuta u periodu od 6 meseci.

Svi zubni uzorci stajali su u veštačkoj pljuvački 6 meseci. Nakon toga, uzorci su tehnikom spaterovanja u vacum evaporatoru pripremnjeni za SEM analizu (JEOL JSM 5300). SEM analizom praćene su mikromorfološke promene u strukturi gleđi na mestima prethodne fiksacije bravica.

Rezultati

Za komparaciju su korišćene bukalne površine zuba na kojima su lepljene bravice, a koji nisu bili podvrgnuti prevenciji (I grupa - kontrolna grupa). U ovoj grupi zapažena je početna demineralizacija gleđnih prizmi (Slika 1. a i b).

U II grupi, u kojoj su zubni uzorci tretirani rastvorom Fluorogala (0,05% F), svakog dana po 1 minut u periodu od 6 meseci, zapažena je inicijalna remineralizacija gleđi (slika 2).

U III grupi, u kojoj su zubni uzorci prevenirani GC Tooth Mousse-om svakog dana po 5 minuta u periodu od 6 meseci, zapaža se inhibicija demineralizacije gleđi i u centru i na periferiji gleđnih prizmi (slika 3).

Aim

The aim of this *in vitro* experimental study was to examine, using scanning electron microscopy (SEM), the ultrastructural changes on the enamel surface after the treatment with different fluoride preparations.

Material and methods

The study involved 30 premolars extracted for othodontic reasons. After the teeth had been conditioned with GC Conditioner, braces were fixed with glass-ionomer cement (Fuji Ortho LC).

All the teeth were divided into three groups:

- I group – controls, without treatment with fluoride solutions;
- II group – tooth samples treated daily with Fluorogal solution (0.05% F) for 1 minute in the period of 6 months;
- III group – tooth samples treated daily with GC Tooth Mousse for 5 minutes in the period of 6 months.

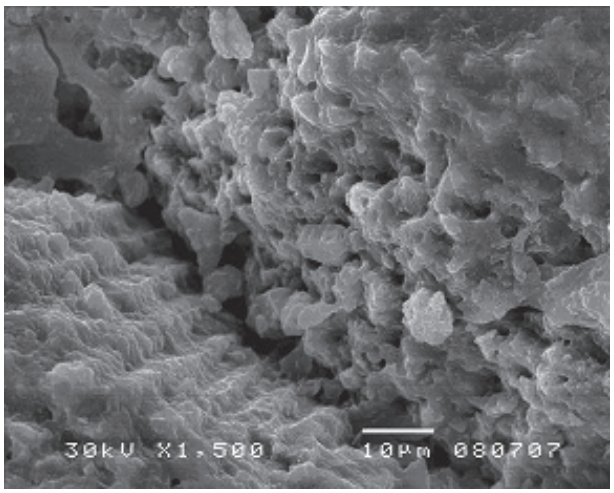
All the samples were kept in artificial saliva for 6 months. After that, the samples were prepared for scanning electron microscopy, SEM (JEOL JSM 5300), using the technique of sputtering in a vacuum evaporator. By way of SEM analysis we monitored micromorphologic, changes in the enamel structure on the places where braces had been previously fixated.

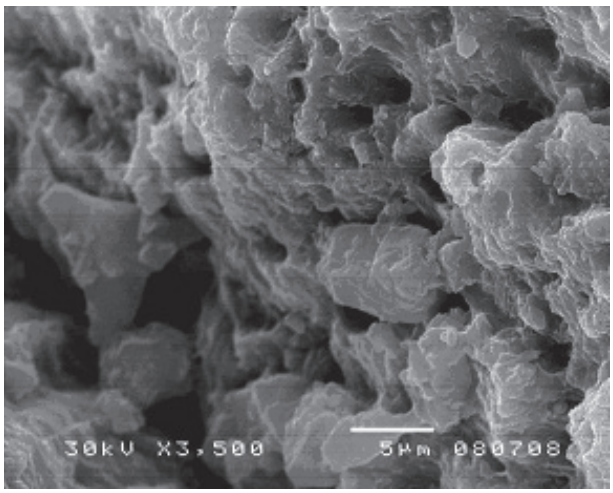
Results

Buccal tooth surfaces onto which braces had been glued and which did not undergo prevention (I group – controls) were used for comparison purposes. In this group, the initial demineralization of enamel prisms was observed (Figure 1a, b).

In II group, in which tooth samples were treated daily with Fluorogal solution (0,05% F) for 1 minute in the period of 6 months, initial enamel remineralization was observed (Figure 2).

In III group, in which tooth samples were treated daily with GC Tooth Mousse for 5 minutes in the period of 6 monthsm the inhibited enamel demineralization was observed, both in the center and the periphery of enamel prisms (Figure 3).

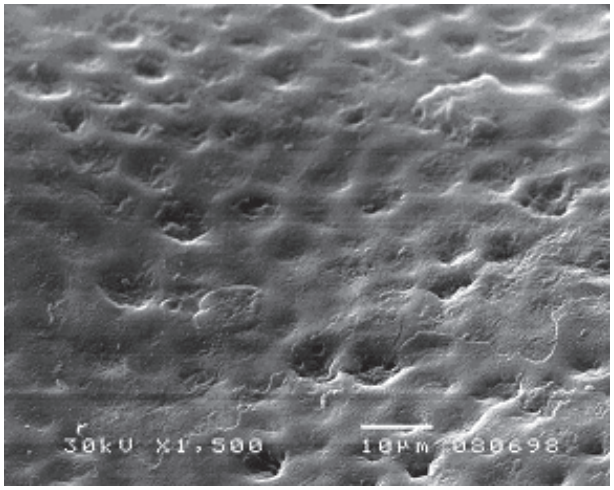




a) *b)*

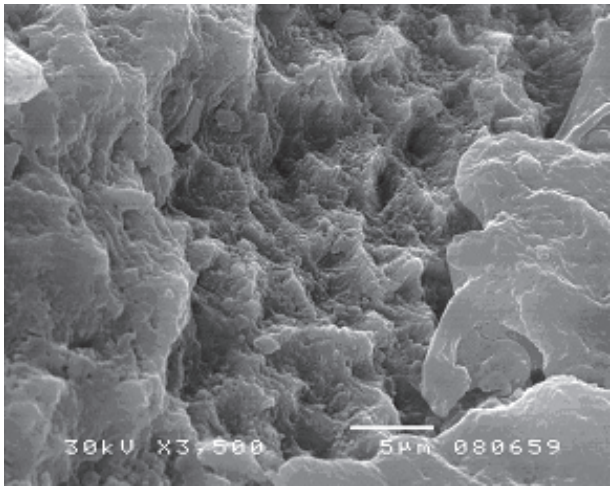
Slika 1. Početna demineralizacija gleđnih prizmi, I grupa-kontrolni uzorak. SEM (a-uvećanje x 1500; b-uvećanje x 3500)

Figure 1. Initial demineralization of enamel prisms, I group – controls, SEM (a – magnification x1500; b – magnification x3500)



Slika 2. Početna remineralizacija gleđi uzoraka tretiranih 0,05% rastvorom Fluorogala (SEM-uvećanje x 1500)

Figure 2. Initial enamel remineralization in the samples treated with 0.05% Fluorogal solution (SEM – magnification x1500)



Slika 3. Inhibicija demineralizacije gleđi u centru i na periferiji gleđnih prizmi. (SEM- uvećanje x 3500)

Figure 3. Inhibition of enamel demineralization in the center and periphery of enamel prisms (SEM – magnification x3500)

Diskusija

Pljuvačka, plak i površina gleđi predstavljaju specifičan i jedinstven biosistem, čiji sastav značajno utiče na procese de- i remineralizacije. Sadržaj plaka i pljuvačke čini prezasićen rastvor soli kalcijuma i fosfora, elemenata koji sačinjavaju gleđ zuba. Pri neutralnoj pH sredini postoji biološka ravnoteža između izlaska i ulaska minerala iz površinskih slojeva gleđi u plake i obrnuto. Međutim, kada dođe do povećanja koncentracije vodonikovih jona u plakovnom sadržaju, dolazi do razlaganja jedinjenja kalcijuma i fosfata i početne demineralizacije gleđi.

Discussion

Saliva, plaque, and enamel surface constitute a specific and unique biosystem, the composition of which has a significant impact on the processes of de- and remineralization. Both plaque and saliva represent an oversaturated solution of the salts of calcium and phosphorus (the constitutive elements of enamel). At neutral pH, there is a biologic balance between the entry and exit of minerals from the superficial layers of enamel and *vice versa*. However, when hydrogen ion concentration is increased in the plaque, calcium compounds and phosphates are degraded and initial enamel demineralization occurs.

Fluoridi su jedno od najefikasnijih sredstava u prevenciji zubnog karijesa. U prisustvu fluorida dolazi do inhibicije procesa demineralizacije tvrdih zubnih tkiva, stimulišu se procesi remineralizacije; takođe, fluoridi deluju inhibitorno na bakterije u dentalnom plaku[19,20]. Kada se ispituje uloga fluorida u procesima remineralizacije početne kariozne lezije, treba praviti razliku u pogledu uloge koncentrovanih fluorida kratkog dejstva i dugotrajnog dejstva niskokoncentrovanih fluorida. Tako, svakodnevno unošenje niskokoncentrovanih fluorida dovodi do malog ali značajnog povećanja koncentracije fluorida u biosistemu pljuvačka-plak-gleđ, što omogućava prevagu procesa remineralizacije nad procesima demineralizacije. To je i potvrđeno u našoj *in vitro* studiji kod zuba u drugoj eksperimentalnoj grupi. Stalno prisustvo optimalne količine fluorida dovodi do remineralizacije početne karijesne lezije gleđi[21,22].

Zaključak

Dobijeni rezultati u ovoj *in vitro studiji* pokazuju da je SEM-analizom utvrđen najveći remineralizacioni potencijal na zubnim uzorcima koji su svakodnevno 6 meseci izlagani malim dozama fluorida; remineralizacija demineralizovane gleđi je prisutna u obe eksperimentalne grupe zuba, ali je bila izraženija u grupi zuba tretiranih 0,05% rastvorom Fluorogala.

Fluorides are among the most effective agents in dental caries prevention. In the presence of fluorides the process of demineralization of hard dental tissues is inhibited and remineralization is stimulated; moreover, fluorides act to inhibit the bacteria in dental plaque[19,20]. When the role of fluorides in the processes of remineralization of initial carious lesions is examined, the distinction should be made between the role of short-acting fluorides in high concentrations and long-acting fluorides in low concentrations. Daily intake of low-concentrated fluorides leads to a small but significant increase of fluoride concentration in the saliva-plaque-enamel biosystem, enabling the prevalence of remineralization over demineralization processes. This was confirmed in our *in vitro* study as well in tooth samples in II experimental group. A permanent presence of optimal amounts of fluoride leads to remineralization of the initial carious enamel lesion[21,22].

Conclusion

The results of this *in vitro* study indicated, as shown by the SEM analysis, that the highest remineralization potential was present in the tooth samples exposed daily for 6 months to low doses of fluorides; remineralization of demineralized enamel was observed in both experimental groups of teeth, being more pronounced in the group of teeth treated with 0.05% Fluorogal solution.

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