

Original scientific paper

Histopathological changes in dental pulp after preparation of cavities with a high- speed drill

Ivana CIGLAR, Dora NAJŽAR-FLEGER, Tonči STANIČIĆ

Department for Restorative Dentistry Faculty of Dentistry, Zagreb

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Key words: dental pulp, high- speed drill.

Summary

Histopathological changes occur very rapidly in the pulp when the high- speed drill, which cuts into the dentin, is used. In this investigation, we wanted to confirm possible changes occurring in the histology of healthy, vital pulp within the first thirty post-operative minutes. Six premolars extracted for orthodontic reasons in adolescents between 12 and 17 years of age were evaluated. The teeth were removed and serial sections of the specimen, using classical histological procedures, were made. The histological evaluation under the light microscope revealed changes in the pulp, characteristic for acute inflammatory reaction, that is, hyperemia, extravasation of blood cells and aspiration of the odontoblast in dentin tubulus. We concluded that the turbine drill should be used only on the enamel of the tooth. We recommend using the low speed drill with maximal cold water for work on the dentin. Exposed odontoblastic process and tubulus should be protected immediately after the preparation of the cavity.

INTRODUCTION

As stomatological equipment has technologically advanced in the last ten years, the quality of dental work has significantly improved, the effect of the dentist has increased while his physical stress has been reduced, and the patient's discomfort has been alleviated. The introduction of the high-speed drill is the same technological jump as the change from a chisel to the presently classical, electrical low-speed drill, or maybe even more. The strict criteria of biological compatibility, founded on recent scientific investigations of structures, the physiology and function of teeth, require a more critical stand towards the application of technological innovations, including of course, the high-speed drill.

In the sixties, the first results of the investigation of the reaction of pulp tissue during preparation of cavities with a high-speed drill (Kramer¹, Marsland², Brännström³) were reported. The same authors observed a pulp reaction between postoperative day 1 and 15, and noted changes in vital pulp tissue even though cold water and air were used during the preparation.

Our working hypothesis was to confirm whether histological changes occur in healthy, vital pulp within the first 30 postoperative minutes.

MATERIALS AND METHODS

In the investigation we used six premolars (extracted for orthodontic reasons from adolescents between 12 and 17 years of age) which had buccal cavities (V class) prepared with a high-speed drill with a diamond bore to the dentin. Maximally cold water and air were used. The teeth were extracted 30 minutes later, fixed in 10% formaldehyde and decalcified in nitric acid. Then they were placed in paraffin, serially cut and stained with hemalum eosin. Fifty to 60 sections, 10–15 μ m wide, were cut.

RESULTS

The histological evaluation of the serial teeth sections revealed changes in the pulp located immediately under the preparation, which were identified as an acute inflammatory reaction, according to the FDI criteria (Holz⁴). Vasodilatation (Figure 1) was observed in all six teeth, plus hemorrhage in two (Figure 2) and edema in another two (Figure 3). A cellular shift in the tubulus was confirmed with aspiration of the odontoblast in all six teeth (Figure 4). In one specimen, mild infiltration of polymorphonuclear leukocytes was found (Figure 5).

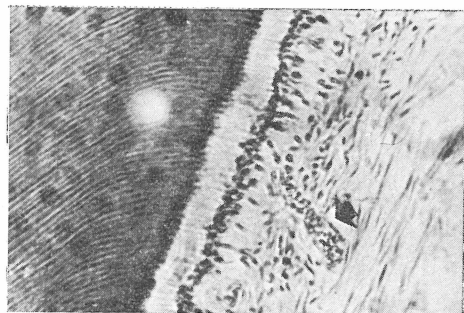


Fig. 1. Vasodilatation (arrow points to the subodontoblastic layer of blood vessel)

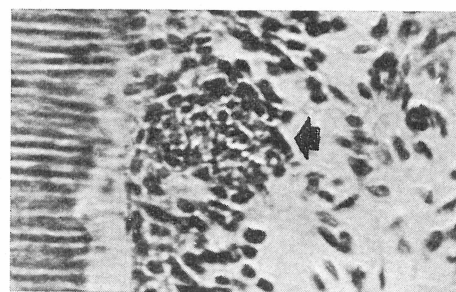


Fig. 2. Hemorrhage (arrow points to mass of erythrocytes in odontoblastic and subodontoblastic layer)

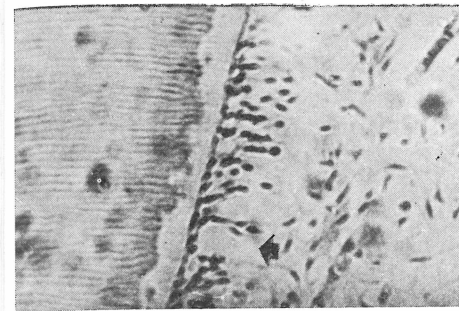


Fig. 3. Edema

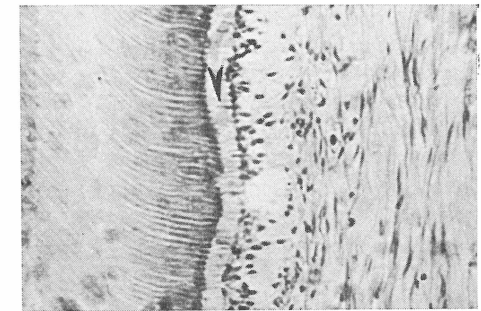


Fig. 4. Aspiration of odontoblast in dentin tubulus

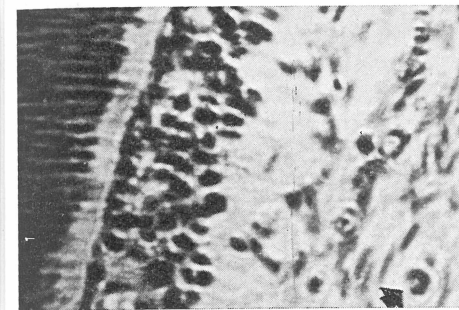


Fig. 5. Infiltration of polymorphonuclear leukocytes

DISCUSSION

Histological evaluation of the results mainly confirmed our working hypothesis that initial changes occur in the dental pulp within 30 minutes after cavities are prepared with the high-speed drill. According to the FDI criteria, these changes in the dental pulp were acute inflammation in stages II and III, or a mild reaction, which is reversible and will not advance if further irritation of the pulp is prevented. A review of literature indicated that present histopathological investigations on the effect of the high-speed drill on the pulp were based on significantly longer postoperative periods than 1 to 15 days (Kramer¹, Marsland², Brännström³, Schuchard⁵, Brown⁶). For this reason, we are unable to directly compare our results with those of the above-mentioned authors even though they significantly correlate. These findings in pulp suggest another important factor; that a direct correlation does not exist between clinical symptoms and the histopathological status. Namely, in our patients, we did not record any subjective symptoms of increased reactivity of the prepared teeth, which conflicts with the histopathological findings.

Any chemical, physical or mechanical factor which comes into contact with dentin necessarily induces changes in the pulp itself. Since dentin and pulp make up a morpho-histological and physiological entity conditioned by the presence of

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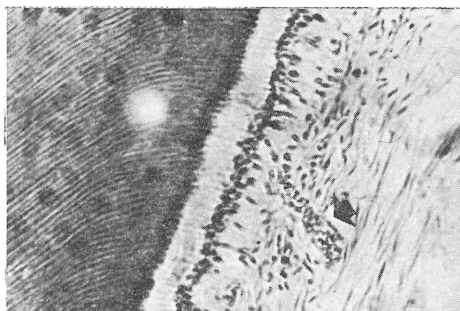


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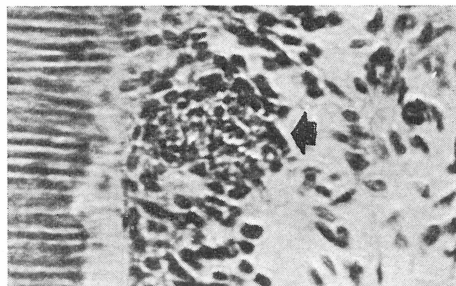


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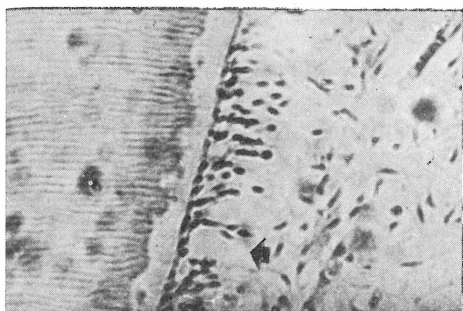


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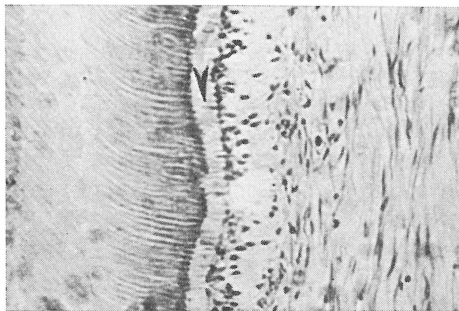


Fig. 4. Aspiration of odontoblast in dentin tubulus

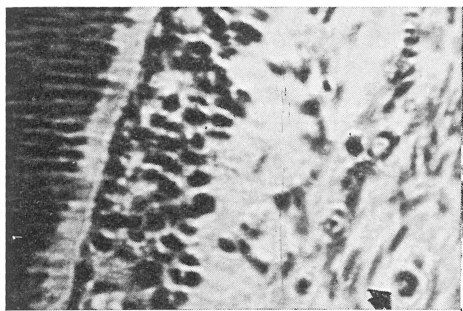


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vital protoplasmatic processus of odontoblast in the dentin, dentin is as vital as the odontoblasts are vital to the pulp. In more concrete terms, although the high-speed drill means a great advancement in the quality and speed of dental preparations, work with it is too rough for the vital structures of the teeth, which are cut, torn and broken. A high temperature then develops (Schuchard⁵, Brown⁶, Bhaskar⁷) which correlates with the rotational speed of the drill. The degree of damage, likewise, depends upon the depth of the preparation, on the shape and size of the drill, on the amount of time the drill is in contact with the hard dental tissue and on the direction and type of cooling of the drill. We believe that the size of exposed surface and depth of the preparation itself particularly influences dental vitality. Namely, threefourths of the cytoplasm of the odontoblast makes up their processus in the dentin tubulus, of which a large part reaches the enamel-dentin junction, i. e. the work area with the high-speed drill. A greater exposed surface of dentin will result in a greater number of cut odontoblastic processus, and a deep cavity, in the loss of more protoplasmic mass. Marked histopathological changes will occur in the pulp. The most drastic example of this is the grinding of teeth for prosthetic appliances, when the total surface of dentin is exhibited. It is assumed that our findings of the reaction to grinding with the high-speed drill will not be the same in older persons because over the years coronary pulp retracts as a result of the apositioning of secondary dentin.

CONCLUSION

When the high-speed drill cuts into the dentin used in the preparation of cavities, histopathological changes rapidly occur in the pulp, and especially in the odontoblastic and subodontoblastic layer. In clinical practice, work is to be used only the high-speed drill in the enamel. We recommend the low-speed drill with maximally cooled water for all other procedures on the dentin, the preparation of cavities and prosthetic grinding. Exposed odontoblastic tubulus should be protected immediately after the preparation.

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S a ž e t a k

PATOHISTOLOŠKA SLIKA ZUBNE PULPE NAKON PREPARACIJE KAVITETA VISOKO-TURAŽNIM BUŠILICAMA

Ključne riječi: zubna pulpa, visoko-turažna bušilica.

Kod preparacija visoko-turažnim bušilicama, koje sežu u dentin, vrlo brzo nastupaju pato-histološke promjene u pulpi. Ovim radom smo htjeli utvrditi moguće promjene u histološkoj slici zdrave, vitalne pulpe, već unutar prvih trideset minuta post-operativno. Koristili smo šest premolara određenih za ekstrakciju iz ortodonskih razloga, adolescenata u dobi od 12 do 17 godina. Zubi su ekstrahirani i načinjeni serijski rezovi preparata, klasičnim histološkim metodama. Histološkom evaluacijom, pod svjetlosnim mikroskopom, smo pronašli promjene u pulpi karakteristične za akutnu upalnu reakciju, tj. peremiju, ekstravazaciju krvnih stanica i aspiraciju odontoblasta u dentinske tubuluse. Zaključili smo da u kliničkoj praksi treba turbinsku bušilicu koristiti samo za rad u caklini. Ostale zahvate u dentinu, preporučujemo raditi nisko-turažnim bušilicama uz maksimalno hlađenje vodom. Eksponirane odontoblastičke nastavke i tubuluse potrebno je odmah nakon preparacije zaštititi.