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Clinical Application of Modern Dental Pins And Their Classification

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The purpose of this work is: to systematize knowledge about dental pins used to restore the morpho functional integrity of the tooth - the structural unit of the alveolar bone system.

Introduction: The use of pins to restore the anatomical and functional integrity of teeth is widespread in dentistry. Pins that are used in dental practice and interact with the hard tissues of the tooth to ensure the quality of the final result of treatment can be called dental pins. Dental pins are mainly considered as retention devices for restoring the anatomy of the crown. The clinical situation that determines the need for the use of pins puts the dentist in front of the need to choose between many types. The complexity of the choice makes it necessary to create a classification. The existing classifications of pins do not adequately reflect their purpose.

Methods and materials: When making pins, certain rules must be followed to ensure good long-term treatment results. According to the dominant concept, the basic rule is to comply with the known requirements for the root and pin. However, the condition of the periodontal, anatomical differences and features of the root, the degree of destruction of the maxillary tooth, the characteristics of the pin used and the occlusal loads to which the restored tooth is subjected should be taken into account in accordance with its group affiliation. It is also important to choose the right size pin. The optimal choice and correct use of the pin largely depends on the experience and skill of the dentist. The use of pins is associated not only with the need to create a retention frame when restoring the anatomical integrity of the tooth. Specialized pins are widely used in endodontics. Their interaction with the hard tissues of the tooth is insignificant, but significant and has a decisive influence on the quality of the final result of treatment. Their use is known as endodontic auxiliary pins. Auxiliary endodontic pins include paper, gutta-percha and silver pins. Paper pins are used not only to drain the root canal, but also to inject drugs into the root canal [10, 11]. Gutta-percha pins (α- and β-) and thermophillic obturators seal and attach the root filling material to the canal wall throughout the root canal, preventing micro-penetration [11]. Gutta-percha is widely used due to its biocompatibility, X-ray transparency and uniformity of volume. Gutta-percha pins are non-irritating and non-toxic to surrounding tissues and, if necessary, can be easily removed from the root canal. The latter requires more attention from dentists when preparing and restoring inactive teeth with pins. The best sealing and the most reliable barrier between the tooth cavity and periodontal tissues consists in filling the root canal with a component of alpha-gutta-percha. Currently, silver teeth are rarely used in endodontics. Endodontic treatment requires preventive but gentle scraping of the hard tissues of the tooth to ensure access to the tooth and the quality of endodontic treatment. Factors such as unavoidable anatomical destruction, loss of dentin volume and loss of water by dentin weaken the physical and mechanical properties of the tooth over time (13,14). Therefore, all endodontic treatment usually ends with the installation of a root canal in the root canal [1, 4, 9]. Intraoral (endocanal) pins reinforced with metal, ceramics or fiber are traditionally used as reinforcing pins [6, 7]. Reinforced pins usually do not have sharp differences in shape and diameter at the junction of the root into the crown. To improve the fixation of the restoration material, recesses or grooves are made in the crown part of the reinforcing pin (Fig. 1). With a decrease in the supra-gingival structure of the tooth, normal chewing forces act not only on the remaining tooth wall, but also on the pin used to repair the defect. The functional load has a negative deformation effect on the structure after creation, especially on its horizontal components [2, 8, 12]. The ability to withstand deformation loads is higher for objects with monolithic structures. Dental pins are used to restore the anatomical and functional integrity of teeth and can be objects made of dissimilar materials. With a severe fracture of the crown, the ability of the restored tooth to withstand deformation loads depends on the strength of the connection between the structural material of the pin and the hard tissues of the tooth. A special role of pins used as therapeutic frameworks is assigned to their ability to provide the maximum possible contact area with the tooth wall, preserve it in all chewing situations and securely hold fixing and restoration materials on its surface. Due to the anatomical features of the teeth and the conditions of endodontic treatment, pins with cylindrical or cylindrical roots are considered the most suitable for use in prostheses. The diameter of the pulp chamber of the tooth of the correct shape is larger than the diameter of the root canal. After endodontic treatment, the diameter of the prepared pulp cavity is usually larger than the diameter of the filling in the area of the mouth of the root canal. In order for the surface area of the dental pin to be as large as possible, the diameter of its crown part (head) should be larger than the diameter of the root canal part (shank). The relevance of a pin with a larger head increases with an increase in the size of the crown defect. The large head increases the surface area of the restoration and effectively fills the lost volume of the tooth. It is important to ensure reliable fixation of the crown part of the pin on the root dentine, for which a relief base should be prepared. The support pads reduce the wedging effect of the pin on the surface wall of the root in case of increased load (Fig. 2). The adhesion of the pin surface to the dentin is necessary for effective and uniform transmission of the chewing load in the "tooth - pin construction" system and is the prevention of deformation fracture of the restored tooth. In clinical situations, when the crown is severely destroyed, pin hoops with support brackets are used at the transition between the root and the crown (Fig. 3). The width of the crown (pronounced shoulder) of the pin is commensurate with the size of the crown defect and the trace of the root canal. The shape of the pin on the root surface should be cylindrical with minimal narrowing, and its length should reach (if possible) to the border of the root seal adjacent to the tip. Retention pin is a dental pin with design features that allow achieving the clinical results described above. Pins are used to effectively fill tooth defects with dental fillings. If the conditions ensuring maximum contact of the retention pin surface with the hard tissues of the tooth are not met, the clinical effectiveness of its use is reduced to the effectiveness of the use of the pin to strengthen the tooth (Fig. 4). In the treatment of patients with dental fractures, the treatment strategy depends on the patient's age, type of occlusion, topography of the fracture line, the condition of the upper jaw periodontal, the condition of pulp and the degree of displacement of the fragment. In the case of root fractures with displacement of usable fragments, the tactics of their compression (reposition) is justified. This tactic is used for a transverse fracture of 1/4 of the crown and 1/3 of the tip of the root. Active pins with a pronounced support shoulder at the crown are best suited for leveling fractured fragments of the root. The main stages of the reposition: 1) removal of pulp; 2) filling of the root canal; 3) preparation of the crown of the fractured root for passive interaction with the selected surface of the pin; 4) special preparation of the apical end of the fractured root for active interaction with the surface of the pin; 5) screwing in the attached active pin and using a sealant to combine the displaced crown and the apical end of the broken root. Repositioning Features - Measure the distance between the displaced root fragments (the width of the fracture line) on radiographs. - Remove the root seal from the apical part of the root so that the total working depth of the channel is greater than the length of the shank of the selected pin and greater than the previously measured distance between the root fragments. - Combine the preparation of the root canal walls to ensure free movement and gradual sliding and passive interaction of the pin surface with the destroyed crown part of the root. A pin inside the root canal that connects the broken parts of the tooth and restores their integrity. The term "reposition (fusion)" does not describe the end result of treatment - restoration of tooth function. Dentosynthesis is the surgical connection of a broken tooth with a fixed structure to ensure the long-term functional stability of the maxillary segment. Successful dentosynthesis does not restore the trophism of the deactivated tooth, but it can completely restore its function. Dentosynthesis pins used for root fractures have a support arm for the crown, a smooth cylindrical shank base and an apical thread. To improve the sliding of the pin surface along the wall of the root canal of a broken tooth, the shank does not have a thread at the base (Fig. 5). Improving the functional stability of a tooth with pathological mobility is an urgent dental problem. An alternative to using a splinting prosthesis is to install a pin implant through a previously expanded (in diameter) root canal and its apical opening (Fig. 6). In the literature, this technique is described as endodontic-intraossal-periosteal implants, and pins interacting with tooth tissues and underlying bone structures are called endodontic-intraossal-periosteal, transdental or transradicular implants. The use of implant pins is highly effective and significantly reduces the mobility of teeth [3]. The endodontic-intraossal implantation method involves the installation of a pin with a spiral or curly surface into the bone tissue at the root end of the tooth through the dental canal. The prerequisites for using this technique are 1) patency of the root canal, 2) sufficient bone layer to fix the implanted part of the pin, and 3) the suitability of the implant structure for future load on the tooth and as a support for the denture [5]. Implants that interact with the hard tissues of the tooth and underlying bone structures can be considered dental structures that relate equally to dental pins and intraosseous implants. The best therapeutic effect from their use is achieved under the condition of equal or greater working ratio of endodontic and endosteal interaction of the post-implant with the tooth area without lines of resorption of the alveolar bone and attachment of the periodontal ligament. The advantage of combined endodontic and endosteal interaction is the absence of direct contact between the implant and the oral cavity. Therefore, a healthy periodontal barrier is important, preventing the spread of infection to the implant installed in the bone (3). The above confirms the principles of classification: 1. Dental pins used to restore the morphofunctional integrity of teeth have specific characteristics that make it possible to

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determine their main clinical purpose. Depending on this purpose, groups containing the corresponding racks are allocated. The first group is endodontic auxiliary pins used at the stage of endodontic treatment of the tooth. The second group includes reinforcing pins (installed in the root canal of an inactivated tooth to increase its strength characteristics). The third group includes support-retaining pins (perform a support-retaining function and provide permanent attachment of the dental structure to the hard tissues of the tooth). The fourth group includes pins for dentosynthesis (provide high-quality reposition, fixation and stabilization of damaged parts of the tooth). The fifth group includes pins for implants (which increase the stability of the tooth, providing a fixed connection with the underlying bone structure)2. Factors affecting individual clinical situations include the size, shape, manufacturing technique and materials of pins (with different physical and mechanical properties), fixation methods and the type of interaction between the pin and the hard tissues of the tooth. The type of interaction between the pin and the hard tissues of the tooth has an impact. With the development of technology, materials have improved and new possibilities have appeared for combining them to achieve the best treatment effect. The main difference between the pins is in the characteristics that allow them to be classified. The proposed classification is based on a review of scientific and professional literature and thematic publications in peer-reviewed journals. The classification is based on the design features of the pins, their physical and mechanical properties and topography in relation to the anatomy of the tooth, which are crucial for variations in clinical application. There are no analogues of the classification of dental pins.

Conclusion: The pins belonging to a certain group for their main purpose does not have strict regulations for their clinical use, therefore, in practical use cases, the following rules should be followed: – dental pins belonging to a group with a large serial number, if necessary, can be used instead of pins belonging to a group with a smaller serial number; – dental pins from the group with a smaller serial number in the case of clinical use instead of pins from groups with a larger serial number are considered temporary, and the therapeutic effect of their use may be unsatisfactory.

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