Technical Note

CONE TEST IN ENDODONTIC THERAPY: A TECHNICAL NOTE

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INTRODUCTION

The cone test is a necessary step in endodontic therapy. This is the connecting line between the conclusion of the shaping phase and the beginning of the root canal obturation phase. So, if this test gives good results, one can move on; alternatively, one must resume the previous phase. It's also necessary to know the quality and characteristics of the cone that will be used in the obturation. In this article, all the operations are listed, explained, and motivated individually, and all the necessary tips to complete them.

Test of the guttapercha cone is one of the essential steps to achieve a good three-dimensional obturation of the endodontic space. It is also a step to verify the accuracy of the previous steps. A good fit of the cone allows us to proceed immediately with the obturation of the canal. In contrast, if it is impossible to find a cone that fits the preparation made, it is good to consider the possibility that the shaping is inadequate and that it is necessary to improve it before making the root canal obturation (1, 2). This article aims to provide clinical suggestions to effectively and efficiently perform this phase of endodontic therapy.

TECHNICAL NOTE

Trying and fitting the cone is an operation that requires a few tools: guttapercha cones, a dedicated gauge, a new scalpel blade, a pair of scissors, a tool to insert the guttapercha cones before obturation, and sodium hypochlorite (NaOCl).

Since knowing the materials being used and having a clear idea of their characteristics is essential for clinical practice, the properties of guttapercha will be summarized shortly. Guttapercha is universally recognized as the material of choice for the obturation of the root canal system.

Essentially, it is characterized by a low coefficient of thermal contraction/expansion, the possibility to be an electrical insulator, compressibility, and plasticity, good dimensional stability once solidified, biocompatibility, radiopacity, ability to be dissolved by appropriate solvents such as chloroform and possibility to be easily sterilized with NaOCl (3).

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Guttapercha for dental use is not “pure” but is obtained by mixing isoprene (18.9-21.8%) with zinc-oxide (59.1-78.3%), heavy metal sulfate (2.5-17.3%), waxes and resins (1- 4.1%), dyes and antioxidants (3%), and fatty acids (traces) (4). Each brand of guttapercha differs from the others: changing the percentages above, cones with different radiopacity, softness, and color are obtained.

In general, the more complex the guttapercha cone, the more inextensible it is and the higher the percentage of zinc oxide inside it; on the other hand, the softer one, the more extensible it is and the higher the concentration of guttapercha. The mere pressure of a fingernail on the cone's surface will indicate its quality: the more definite the imprint, the higher the quality of the guttapercha. (Fig. 1). This aspect, clinically, will be reflected in greater compressibility and heat conduction capacity.

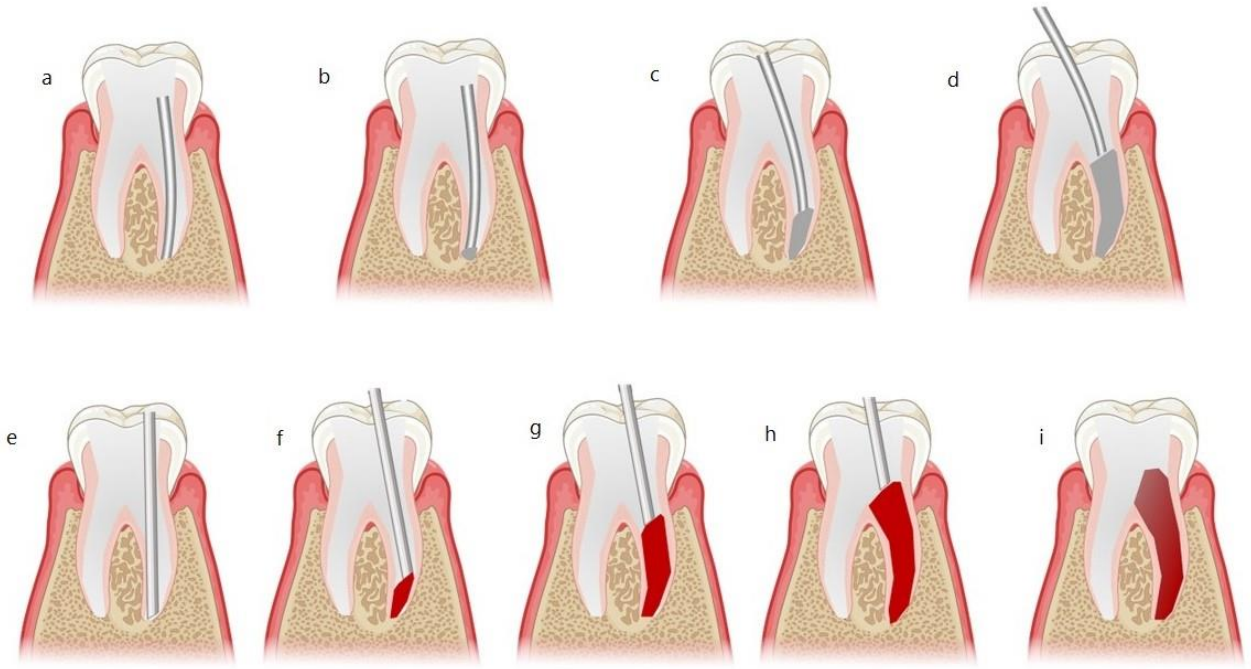

Fig. 1. ***a****): cone quality test;* ***b****): Three different cones with apical diameter 30;* ***c****): Ni-Ti instruments and dedicated cones;* ***d****): cones soaked in NaOCl in a Petri capsule;* ***e****): cone cutting defects;* ***f****): cone elongation: before and after;* ***g****): one folded on itself;* ***h****): twisted cone;* ***i****): Root canal reprocessing: after shaping, the walls are still soiled with endomethasone.*

Guttapercha cones are commercialized in standardized and non-standardized forms. According to ISO standards, standardized cones have tip diameters varying from 0.15 to 1.40 mm. They can have a 0.02, 0.04, or 0.06 taper and are generally used as master cones in lateral condensation or single-cone filling.

Non-standardized cones, on the other hand, are more tapered and sharper than the previous ones. They are available in nine sizes: X-fine, fine-fine, medium-fine, fine (0.06), fine-medium (0.08), medium (0.10), medium-large (0.12), large and extra-large; they can vary considerably depending on the manufacturer (5).

The cones preferred in warm compaction techniques are not standardized because they are better filled to shape produced with rotating Ni-Ti instruments. There are also cones dedicated to the different types of instruments that have a taper corresponding to the root canal instruments used for shaping the root canal; this type of cone can be challenging to use because if its taper is identical to that of the shaping, friction of the cone along the walls may impede its descent into the canal. In these cases, it is often preferable to choose the cone corresponding to the instrument of lower taper than the one brought to the working measurement.

The cone should fit the shape developed by the shaping; it is important to know the diameters and taper of the root canal instruments used for shaping, as this will make it easier to select the cone of the correct size. When testing the cone, it is good to remember the following decalogue:

1. the cone must be clean;
2. it must be cut well;
3. it must be longer than the channel;
4. it must go down inside the channel without bending;
5. it must not curl;

6. it must reach the end of the channel;
7. must have apical tug back;
8. must not be accessible in the canal;
9. cone insertion must be repeatable;
10. a radiographic test must be performed. The points will be analyzed one by one.

The decalogue for the cone test

1. The cone must be clean. It is a good idea to keep the guttapercha cones soaking in hypochlorite in a tool for guttapercha cone cleaning to make them as aseptic as possible: 60 seconds is sufficient to eradicate even Bacillus subtilis spores (6, 7).
2. The cone must be cut well. To make a precise cut, scalpels, micro-scissors, a proper cutting technique, and a zooming system must be used (4). This will help eliminate cutting defects that sometimes lead to a lack of tug back or incomplete descent of the cone within the canal (8).
3. The cone should be longer than the canal. In cases where the canals are exceptionally long, the test steps may be complex because of the cone size. Trying a 21-mm-long cone (e.g., a fine-medium cone with a diameter of 40) in a 22-long canal can be complex, especially when cutting the most apical portion or the adequacy of the tug back. In these cases, it is useful to heat a portion of a guttapercha cone and attach it to the head of the cone to be tested, resulting in a longer and very stable cone.
4. The cone should descend inside the canal without bending. In posterior areas, in patients with limited mouth openings, in difficult-to-access canals such as the mesial or mesiobuccally canal of upper molars, or in the presence of very coronal and large ledge (e.g., after removal of screw-retained posts), it may happen that the cone, before entering the canal, bumps against the floor or walls of the pulp chamber, folded on itself. When this happens, cutting or bending the cone in its coronal portion is advisable to obtain more space for a maneuver. Another solution may be to harden the guttapercha cones by soaking them for a few minutes in pure alcohol. If the cones break during this phase, the guttapercha cones may be damaged.
5. The cone should not twist. In some cases, the cone, before reaching the root apex, undergoes a compressive force that causes a twist: this frequently occurs in re-treatments, when the canals have been greatly widened in the coronal and middle portions, or complex anatomies marked by blockages ledges or sudden changes in direction; the same can also occur in the presence of an excessively reduced taper of the guttapercha cone.
1. In these eventualities, the problem must be identified early and, if possible, resolved. Modifying the anatomy by re-preparing the canal is a viable option only when there is useful space for preparation.
2. If the tooth has already been extensively prepared, on the other hand, rather than weakening an already fragile root, it is advisable to use a higher taper guttapercha cone. A step in alcohol, as previously described, may be helpful in case the cone bends (9).
6. The cone should reach the end of the canal and not exceed it. When this does not happen, there can be many causes: the apical diameter has not been understood, the canal is not well shaped, or the preparation does not reach the right length. In retreatments, intracanal obstructions (e.g., broken instrumentation) or inorganic material (e.g., guttapercha residues, pastes, and cement) can hinder cone advancement. The solution is to understand any shaping error, understand the apical diameters, and clean the canal well of the material; in the latter case, using ultrasound instruments or debrider is a valuable aid, especially if the procedure is done with an operating microscope.
7. The cone must have an apical tug back. The guttapercha cone will have friction against the canal walls, and it is necessary to be certain that this is in the apical, not coronal, part to have a three-dimensional filling and avoid overfilling or underfilling. To be sure of the above, it is useful to try a smaller taper and the same tip's diameter second cone and note its size: if the length of the two cones is identical, it is sure that the cone is frictional apically and not coronal. If, on the other hand, the lower taper cone has a longer length, it means that the apical diameter is not correct, and the apex should be remeasured. The smaller cone is more reliable in measuring apical diameter than the cone of greater taper (10, 11).
8. Friction of the cone along the canal walls causes the appearance of tiny visible striations on its surface: if the striations are in the apical third, they confirm tug back in this area.
9. The absence of tug back may be due to debris within the canal lumen, which prevents proper friction of the cone on the walls or less tapering of the cone compared to the preparation. To solve the problem, ultrasound instruments will be sufficient to clean the canal of organic tissue or increase the taper of the cone without changing the tip diameter.

10. The cone should not be free in the canal. Generally, cones have a taper similar to the instruments used for shaping; for this reason, a cone with a diameter corresponding to the apical diameter should be selected and never undersized compared to it. Moreover, the taper must be similar to the preparation, at least in the apical third. If this does not happen, portions of the cone in the canal will be free: having a free cone in the coronal portions of the canal is a problem that can be easily remedied during obturation; if, instead, this occurs at the apical level there will be absence of seal and overfilling.
11. The insertion of the cone must be repeatable. Whenever the guttapercha cone is inserted inside the canal, it must be repeatable, the length must be constant, and the same tug back must always be manifested. The cone containing sodium hypochlorite is inserted into the canal. During such tests, it is advisable to move the cone to activate the irrigants: this activation is not comparable to that obtained with ultrasound; however, it is an easy way to increase the effectiveness of sodium hypochlorite.
12. A radiographic test should be done. Taking an X-ray with the cones inserted provides an opportunity to evaluate some of the points above; it also allows us to verify the working lengths and the fit of the cone to the walls. If the radiograph confirms the selected cone is appropriate, root canal obturation can be initiated.

CONCLUSIONS

Knowing the taper of the shaping, understanding the apical diameter of the canal, and performing good irrigation will speed up the steps described in the decalogue. A good root canal obturation depends on the correctness of the previous steps.

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