In Vitro Evaluation of Cleaning Effectiveness of EndoActivator vs Tornado Disinfection Kit

Microbiological Laboratory Laniado Hospital, Israel

Objectives and Purpose

Goal

This in vitro study is aimed to compare the antibacterial effect of EndoActivator (Dentsply) and the Tornado Disinfection Kit (MedicNRG)

Objective

To compare disinfection effect of the two different systems by bacteria quantitative testing before and after system use on tooth root canal.

Systems brief description

EndoActivator (Dentsply) is a sonic device used to activate the irrigation solution to assist in cleaning and disinfecting canals after shaping with hand or rotary files. System includes handpiece and 3 tips of different sizes.

Tornado Disinfection Kit (MedicNRG) is a rotary device using centrifugal force to activate solution for cleaning and disinfecting canals after shaping with hand and/or rotary files, especially designed to reach canal parts that are unreachable by NiTi rotary instruments. System includes handpiece, Gentlefile Red and GF Finisher Brush:

- Gentlefile (GF) Red – abrasive rotary stainless steel file. Its function is to shape and clean untouched parts of the canal left by NiTi rotary files.
- Gentlefile (GF) Finisher Brush – a special instrument made of 6 stainless steel fine wires. Its function is to activate solution and mechanically scrub canal walls for thorough cleaning and disinfection after mechanical debridement.

Method and Protocol

39 extracted molar and pre-molar teeth were selected among a total of 60 tooth, according to the protocol requirements (size and shape). The teeth were sectioned into separate canals while formed canals were relatively straight for preliminary investigation, easily accessible by the two different instruments.

Canal Preparation:

All the canals were prepared for root canal treatment using standard technique: K File # 10 > Gentlefile Abrasive hand file 0.17 > K file #20 > Rotary NiTi file 0.25 (taper 04)
All canal were irrigated during and after preparation with 2% sodium hypochlorite solution (NaOCl) and sterilized in a steam autoclave.

Canal Sealing and Inoculation:

At the end of the preparation, the teeth were embedded in epoxy glue to ensure apex absolute sealing.
All canals were then inoculated with 30 cc bacterial solution (Enterococcus faecalis), except negative control group.

Testing Group:

Canals were divided into 4 groups:
Negative Control: no bacteria inoculation.
Positive Control: bacterial inoculation without disinfection process.
2 comparative groups (17 canals each one): bacterial inoculation and solution activation by the two different systems. All canals were irrigated with 2% NaOCl solution and activated with instruments according to their manufacturer's protocol.
The EndoActivator group was split in two subgroups for 30 sec. and 60 sec. activation, according to the manufacture protocol range.

Protocol

Solution Activation:
The solution was agitated for 30 seconds in all canal using respective system.
EndoActivator 60 sec. group canals were activated for 30 sec., then irrigated with 2% NaOCl and activated again for 30 sec.
The solution activation of the Tornado group was performed as manufacturer protocol: 30 sec. cleaning and activation using Red 0.25 GF file and following by 30 sec. activation with Tornado Finisher Brush.

Bacterial quantification:
Culture medium was prepared in test tubes, according to microbiological protocol.
At the end of solution activation phase, all canals were penetrated with 0.25 paper points for 5 sec.
Paper points were transferred to culture medium and test tubes underwent vibration and mixing using a Vertex vibrator.
Test tubes were incubated for 20 hours in appropriate temperature in order to enhance bacterial growth.
After 20 hours, two samples of each test tube were collected and plated on standard Petri dishes (adapted for the specific bacteria).
Then test tubes were incubated for additional 24h, after when second samples were collected and plated as first samples protocol.
Bacterial quantification was performed under statistical evaluation process (BMDP).

Note: during process, one tooth of EndoActivator group brake, and therefore was removed from the test

Results

Tornado + 2% NaOCl

Tooth No.	Substrate	Bacterial Count after 24 hours	Bacterial Count after 48 hours
1	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
2	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
3	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
4	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
5	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
6	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
7	Tornado + 2% NaCO :30sec GF+30sec Brush	0	0
8	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
9	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
10	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
11	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
12	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
13	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
14	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
15	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
16	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0
17	Tornado + 2% NaCOl :30sec GF+30sec Brush	0	0

EndoActivator + 2% NaOCl

Tooth No.	Substrate	Bacterial Count after 24 hours	Bacterial Count after 48 hours
30	30 Sec. Endoactivator + 2% NaCOl	35,000	≈ 50,000
31	30 Sec. Endoactivator + 2% NaCOl	30,000	≈ 50,000
32	30 Sec. Endoactivator + 2% NaCOl	40,000	≈ 50,000
33	30 Sec. Endoactivator + 2% NaCOl	30,000	≈ 50,000
34	30 Sec. Endoactivator + 2% NaCOl	72 col*	≈ 36,000
35	30 Sec. Endoactivator + 2% NaCOl	25000	≈ 50,000
36	30 Sec. Endoactivator + 2% NaCOl	50	≈ 25,000
37	60 Sec. Endoactivator + 2% NaCOl	60	≈ 30,000
38	60 Sec. Endoactivator + 2% NaCOl	21	≈ 10,500
39	60 Sec. Endoactivator + 2% NaCOl	20,000	≈ 50,000
40	60 Sec. Endoactivator + 2% NaCOl	30,000	≈ 50,000
41	60 Sec. Endoactivator + 2% NaCOl	35 col*	≈ 17,500
42	60 Sec. Endoactivator + 2% NaCOl	40,000	≈ 50,000
43	60 Sec. Endoactivator + 2% NaCOl	32 col*	≈ 16,000
44	60 Sec. Endoactivator + 2% NaCOl	35000	≈ 50,000
45	60 Sec. Endoactivator + 2% NaCOl	72 col*	≈ 36,000
46	60 Sec. Endoactivator + 2% NaCOl	32 col*	≈ 16,000

* col= bacteria colonies

Control

Tooth No.	Substrate -	Bacterial Count after 24 hours	Bacterial Count after 48 hours
55	Positive control	100 col	5x10^5
56	Positive control	40 col	200.000
57	Positive control	35 col	175.000
58	Positive control	100 col	5x10^5
59	Negative control (distilled water)	0	0.000
60	Negative control (distilled water)	0	0.000

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Statistical Analysis

Statistical analysis was performed using the Mann-Whitney U-test for non-parametric data with corrections for multiple comparisons, using the statistical package BMDP (ref).
No statistical difference was found in the two EndoActivator groups (30 Sec. EndoActivator + 2% NaOCl and 60 Sec. EndoActivator + 2% NaOCl) so combination of the groups was feasible.
Then comparison between Tornado group (Tornado+ 2% NaOCl) and combined EndoActivator group, as well as with the Positive Control group was performed.

Results

Bacterial Count after 24 hours as well as Bacterial Count after 48 hours were **significantly higher** ($p<0.05$) in 30/60 Sec. Endo-activator + 2% NaOCl when compared with 'Tornado + 2% NaOCl
Bacterial Count after 24 hours as well as Bacterial Count after 48 hours were **significantly higher** ($p<0.05$) in Positive Control group when compared with 'Tornado + 2% NaOCl

Ref: BMDP Statistical Software (1993) Chief Editor: W. J. Dixon University of California Press .Los Angeles

Results and Discussion

EndoActivator sonic device has limited disinfection effect after canal preparation, even in optimal canal condition for disinfection (straight shape)

Tornado Disinfection Kit completely disinfect the canal after preparation, achieving 100% disinfection in all tested canals.

Discussion:

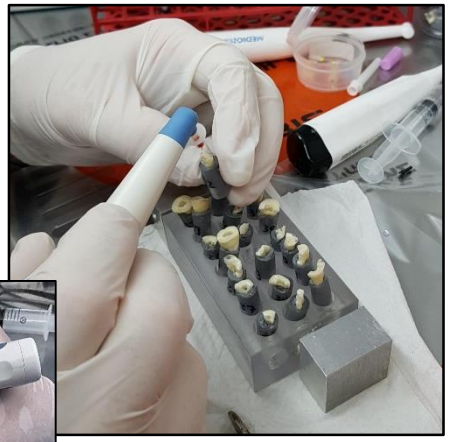
The effectiveness of the Tornado Disinfection Kit may result from its ability to create aggressive activation and turbulences using the centrifugal force of the Gentlefile system, operated by 6500 rpm. Moreover, the Tornado Finisher Brush, designed with unique stainless steel thin strands that open inside the canal when operated, follow canal anatomy, scrub the biofilm and smooth the canal walls simultaneously with solution activation.

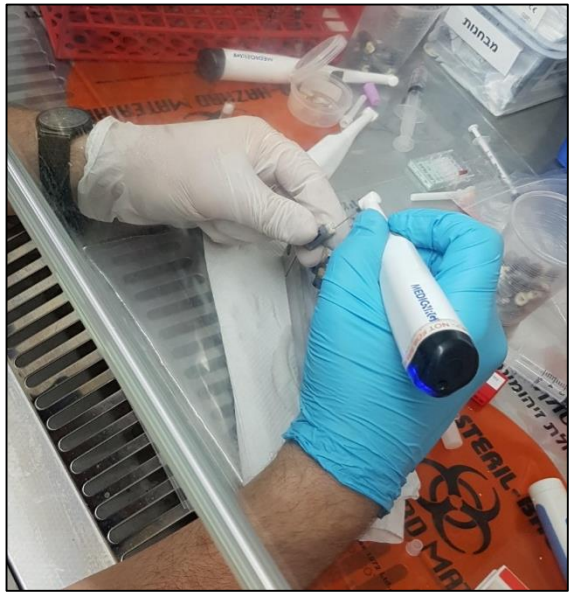
The EndoActivator, based on sonic effect, creates waves. When the tip come in contact with the wall, the tip vibration may decrease and even stop. Theoretically, in the narrower part of the canal, like in the apical third , the sonic effect is insignificant.

Photos

Solution Activation process

EndoActivator

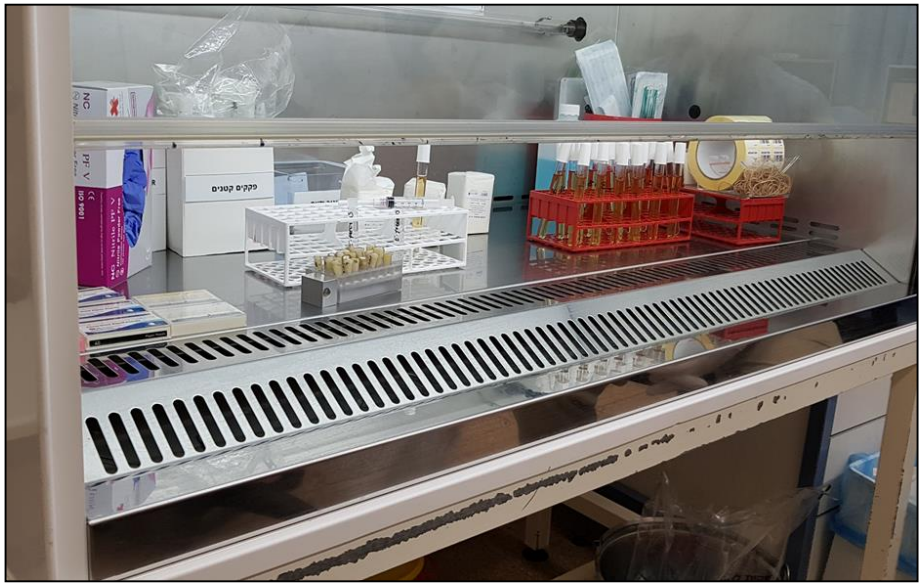




Tornado

Photos

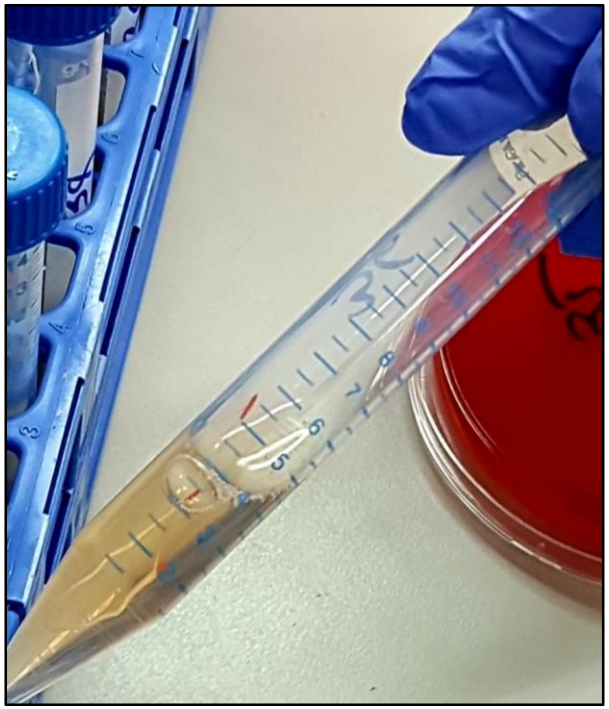
Microbiology Lab environment set up according to protocol



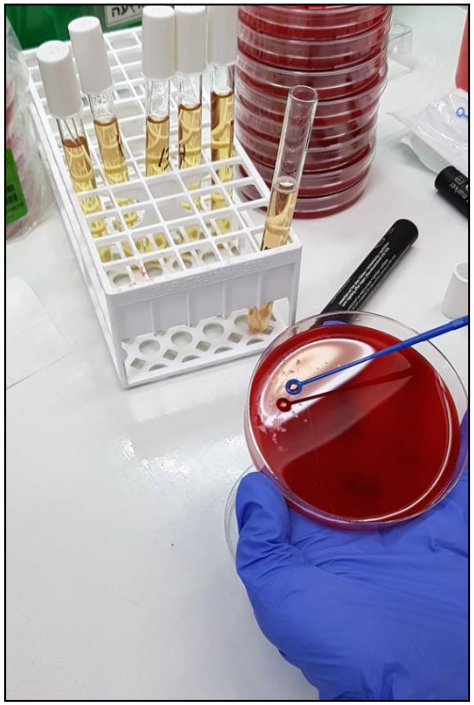
Paper points insertion to test tube with culture medium

Photos

Bacterial proliferation process



Insertion of paper points into culture medium tube



Petri dish inoculation