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**In-vitro Evaluation of Irrigants for the Removal of Smear Layers**

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## Introduction

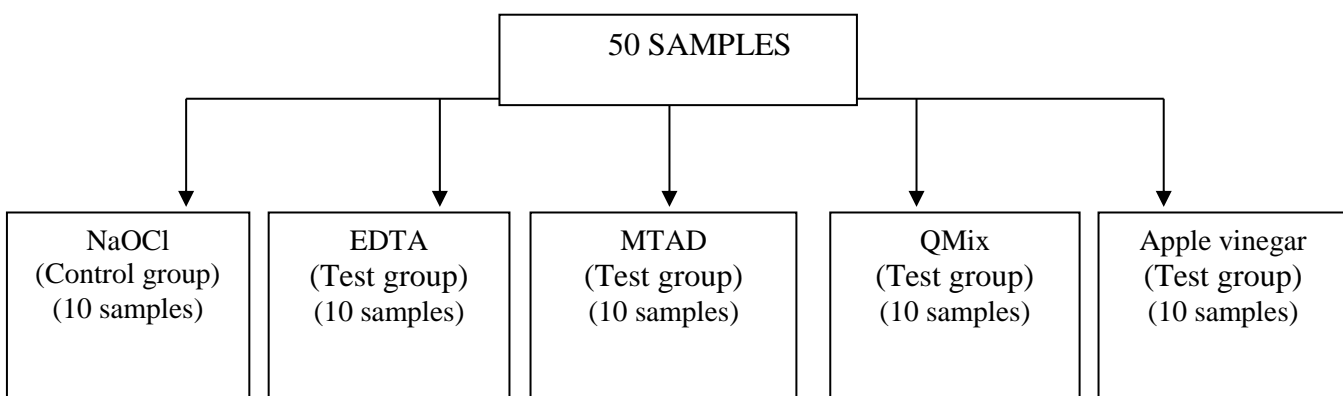
The smear layer formed during canal preparation can cause failure by blocking the dentinal tubule, preventing sealer penetration and hampering bonding. Improper obturation can lead to microleakage and bacteria in the smear layer. Various irrigating materials and solutions are being studied for removing the smear layer. An in-vitro SEM study will use a scanning electron microscope to analyze the effectiveness of different root canal irrigation solutions in removing the smear layer on extracted teeth. This will allow researchers to visually compare the degree of smear layer removal between different irrigants under high magnification.

## Material and Method

All the teeth (N - 50) were decoronated and prepared with the help of # 10-15 K files, Followed by biomechanical preparation with the help of Blueflex files #20-25-30 with 6% taper. Each root canal was prepared to the size of 30 with a 06% taper on the apically. Simultaneously, irrigation was done with the help of Sodium Hypo chloride (NaOCl) 2ml of 5.25%, and final irrigation was done with the help of side vented 30 gauge needles which were 1-2 mm short of apex with different irrigation according to the group. The irrigants were NaOCl, Q mix, MTAD, EDTA, and Apple Vinegar, Followed by drying and examination of all the samples under SEM for smear layer deposition in the apical third of the canal region.

### Grouping of Samples

On the basis of irrigants used in the study –



### Sample preparation:

Collect extracted human teeth with intact root canals.

Prepare root canals using standardized instrumentation techniques.

Divide the samples into groups, each assigned to a different irrigant (e.g., sodium hypochlorite (NaOCl), ethylenediaminetetraacetic acid (EDTA), MTAD, etc.).

**Irrigation procedure:**

Irrigate each root canal with the allocated irrigant solution using a standardized protocol.

Consider different irrigation techniques like passive ultrasonic irrigation or conventional syringe irrigation.

**SEM analysis:**

After irrigation, carefully split the teeth longitudinally to expose the root canal walls.

Dehydrate and mount the specimens on SEM stubs.

Coat the samples with a thin layer of gold using a sputter coater.

Examine the root canal surfaces under SEM at high magnification to assess the presence or absence of smear layer, noting the degree of dentinal tubule opening.

**Data analysis:**

Score the smear layer removal on each sample using a standardized scoring system (e.g., based on the extent of tubule opening, debris coverage).

Compare the mean smear layer scores across different irrigant groups using statistical analysis to identify which irrigant was most effective in removing the smear layer.

**Standardized instrumentation:**

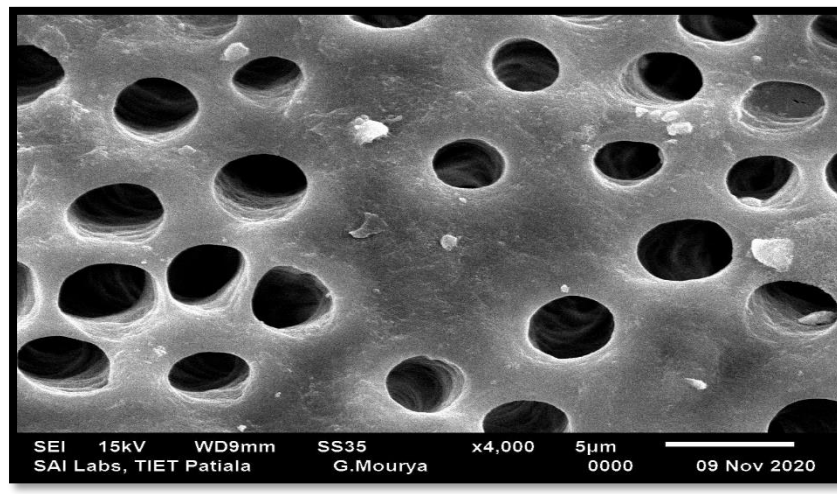
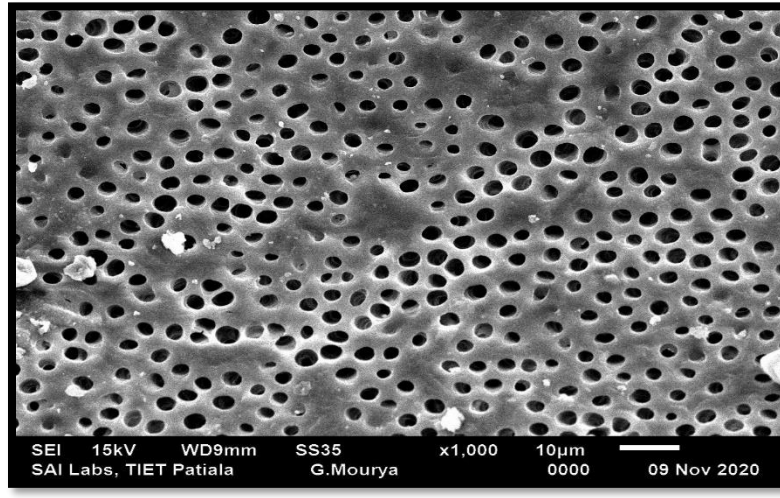
Use consistent root canal preparation techniques to minimize variability in smear layer formation.

**Blinding:**

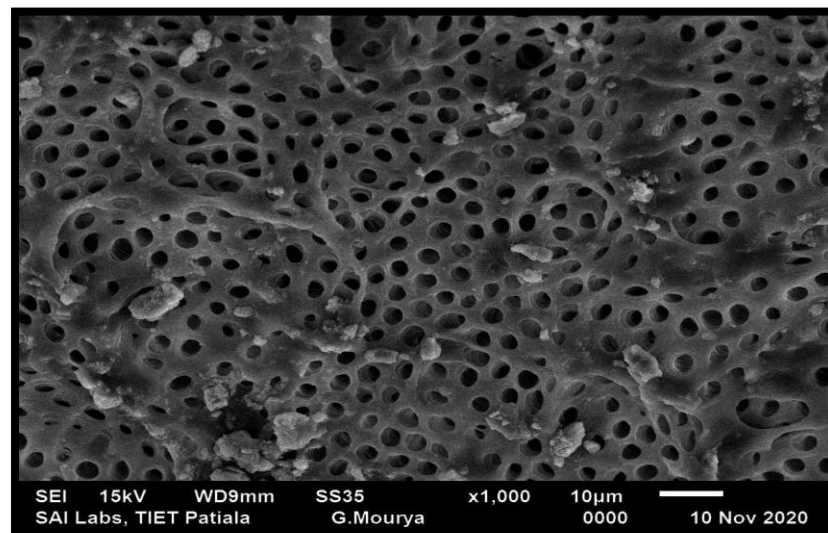
Randomly assign samples to different irrigant groups to minimize bias during analysis.

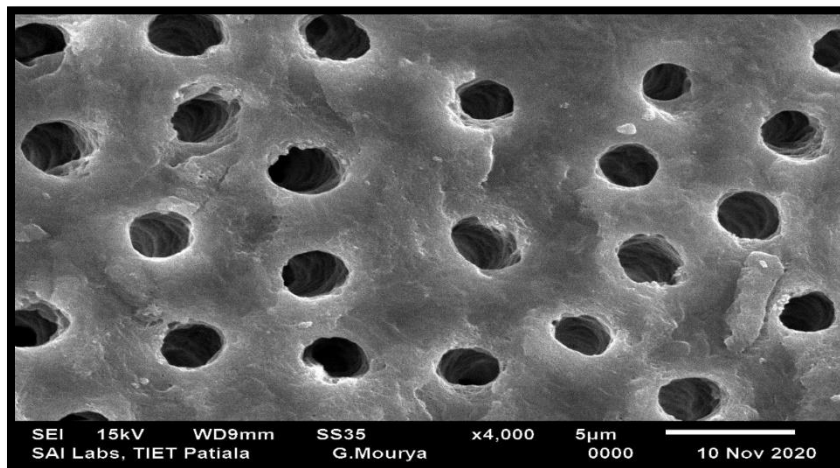
**Sample size:**

Include a sufficient number of samples per group to ensure statistically reliable results.

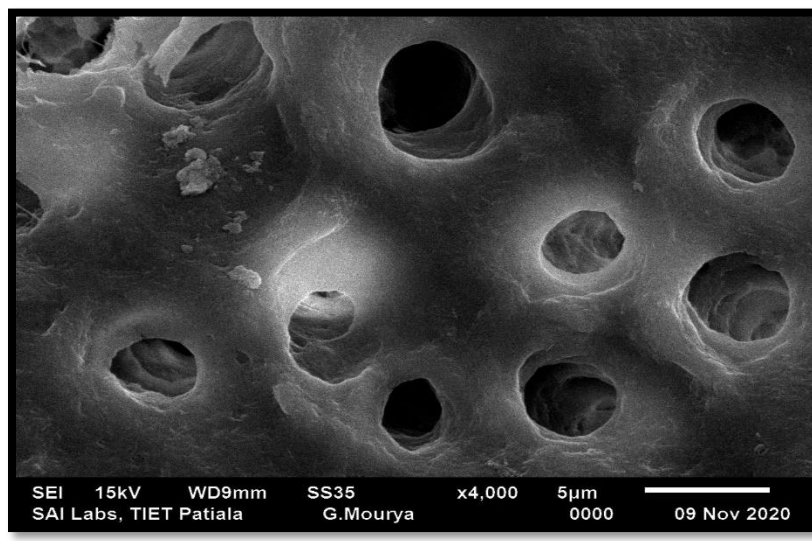
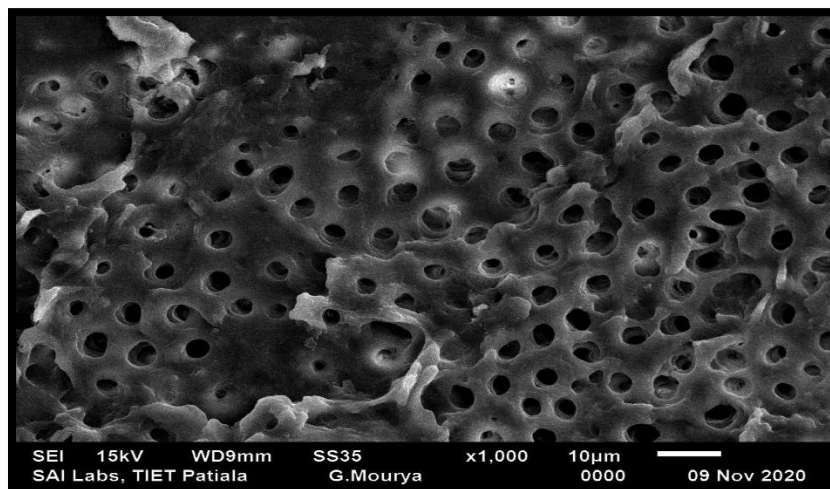


**Qmix**

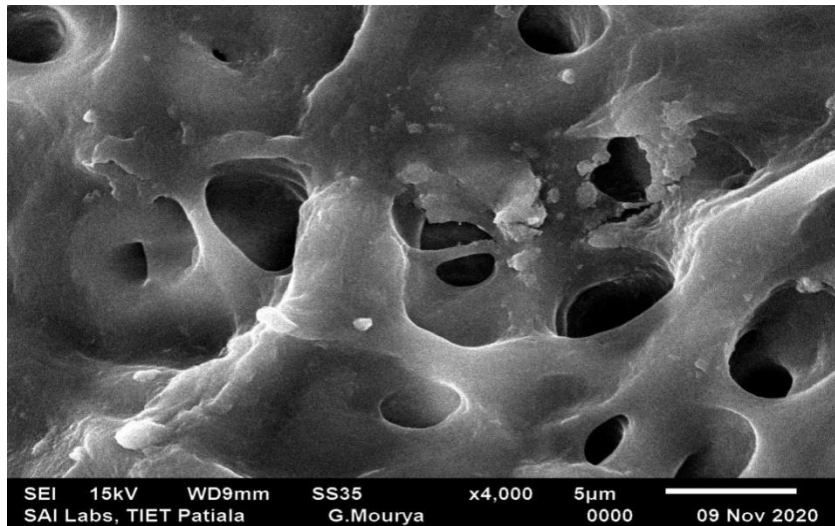
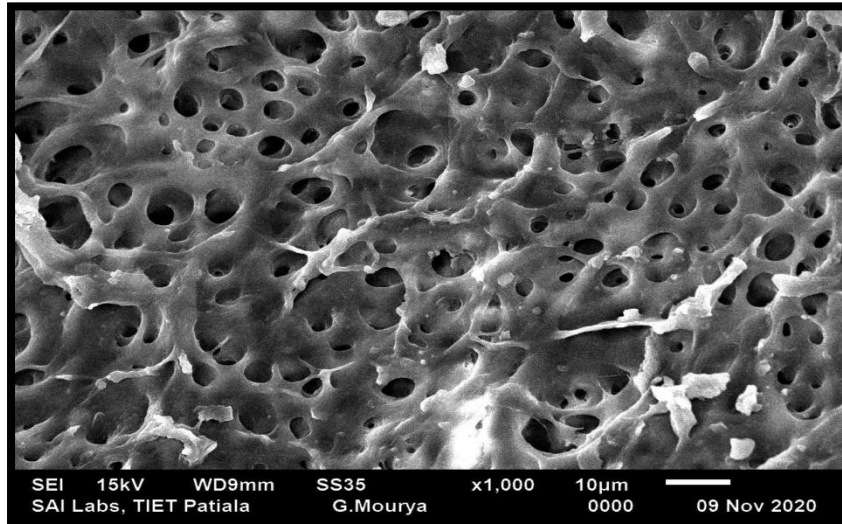




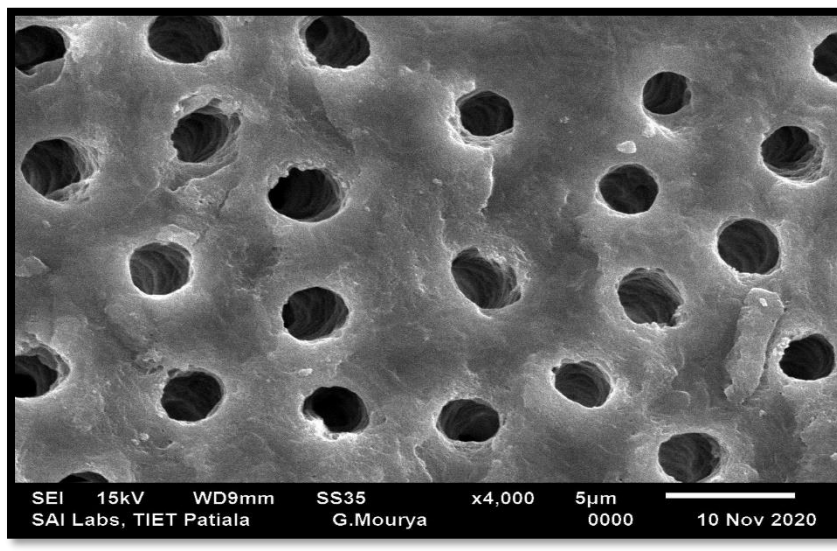
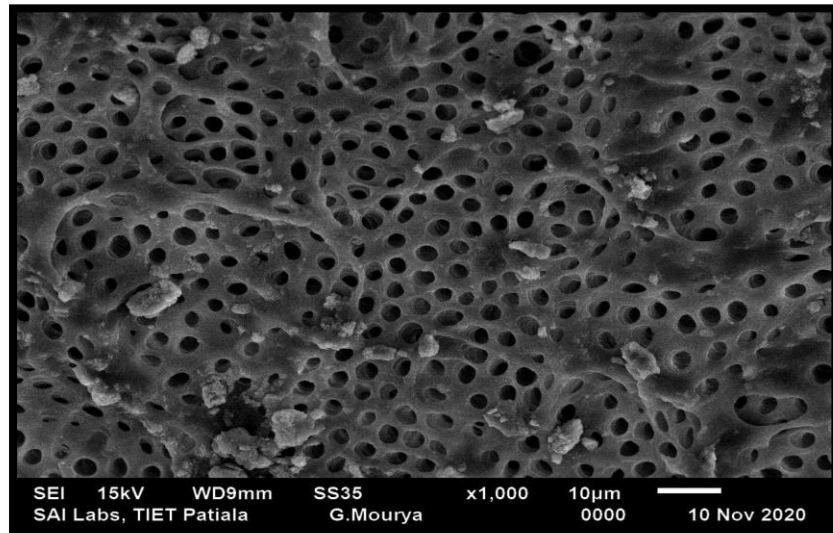
**EDTA**



**MTAD**

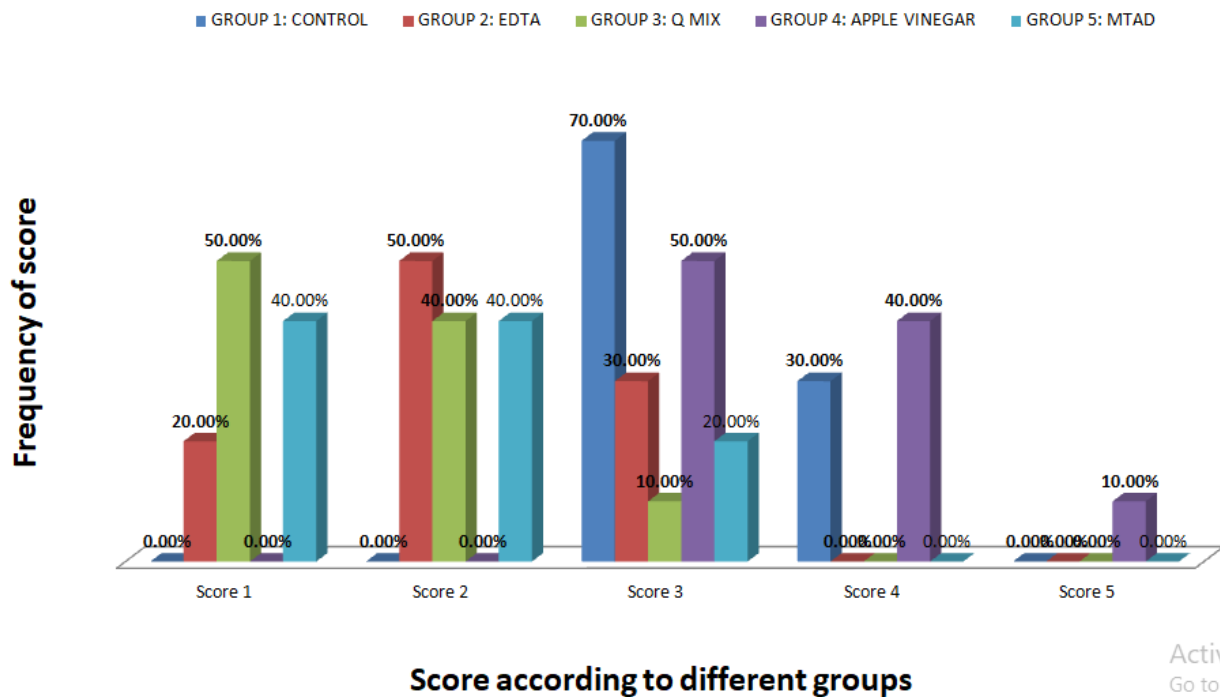


Apple vinegar



NaOCl

### DISRTIBUTION OF SMEAR LAYER SCORES



Activa  
Go to St

### PAIR WISE COMPARSION

	GROUP 2: EDTA	GROUP 3: Q MIX	GROUP 4: APPLE VINEGAR	GROUP 5: MTAD
GROUP 1: CONTROL	0.002*, SIG	0.001*, SIG	0.393, NS	0.001*, SIG
GROUP 2: EDTA	-	0.132, NS	0.001*, SIG	0.436, NS
GROUP 3: Q MIX	-	-	0.001*,SIG	0.631, NS
GROUP 4: APPLE VINEGAR	-	-	-	0.001*, SIG
GROUP 5: MTAD	-	-	-	-

### MANN WHITNEY U TEST



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LEVEL OF SIGNIFICANCE SET AT  $P \leq 0.05$

SIG: SIGNIFICANT

NS: NON SIGNIFICANT

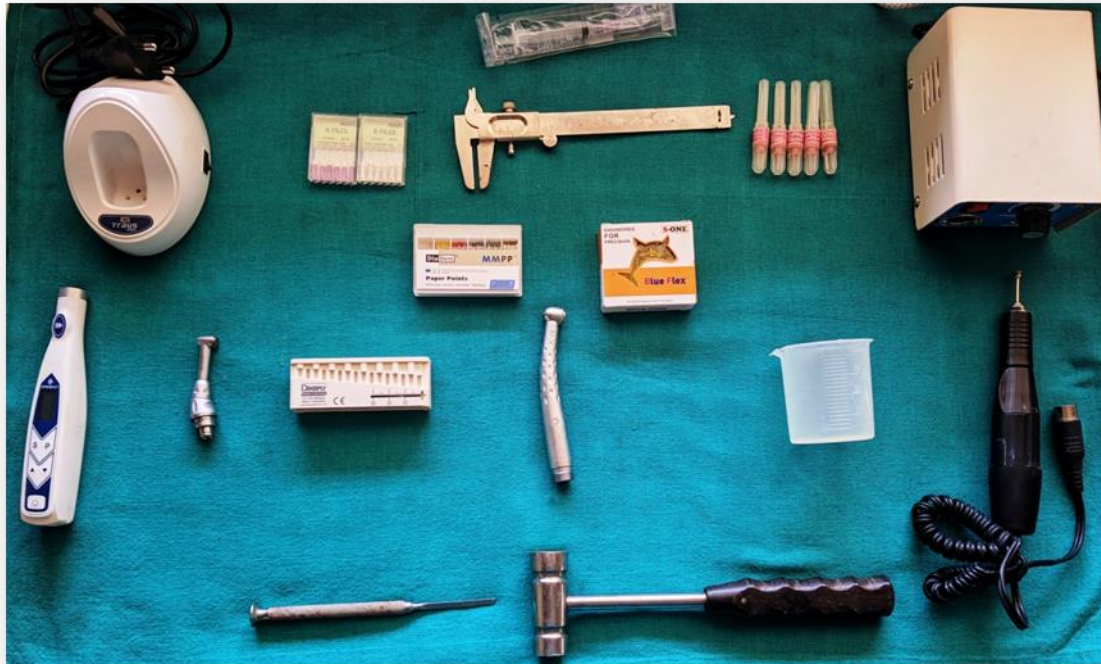


Figure 1

Armamentarium used in the procedure

1. Endomotor (TROUSENDO)
- 2 Syringe (NIPRO)
- 3.K file no # 10-15 (MANI)
4. Vernier calliper
5. 30 gauge side-vented needle (DENTSPLY ProRinse)
6. Micro motor and straight hand piece (API)
7. Paper points (DIADENT)
8. Blue flex rotary file (BLUE FELX)
9. Endo gauge(DENTSPLY)
10. Contra angle Airrotor (APPLEDENT)
11. Beaker (Borosil)
12. Chisel and mallet(API)



Figure – 2 Material used in the study

1. Sodium hypochloride 5% (DENTPRO)
2. Apple vinegar 5%(HEINZ)
3. EDTA(CANALARGE)
4. Q-mix 2in1(DENTSPLY)
5. MTAD(DENTSPLY)

## Conclusion

This study evaluated the effectiveness of various irrigants in removing the smear layer from the apical third of root canals. The results indicated that Q mix demonstrated statistically significant smear layer removal compared to other irrigants, proving to be the most effective in ensuring a clean dentinal surface. In contrast, Apple Vinegar showed the least effectiveness in smear layer removal. These findings emphasize the importance of selecting appropriate irrigants to optimize root canal cleaning, prevent microleakage, and enhance the overall success of endodontic treatment.

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