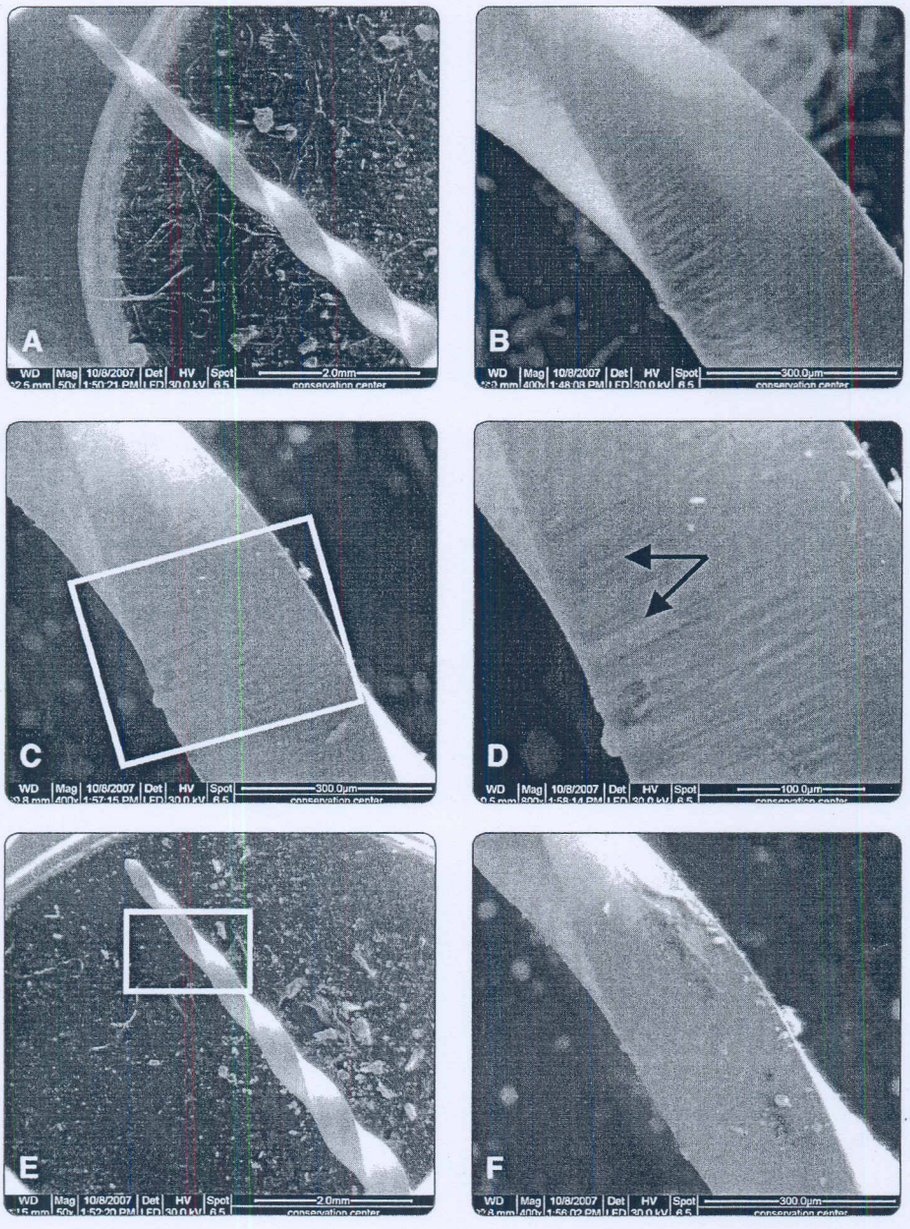


Fig. (2): SEM micrograph of a representative sample of PTU retreatment instrument size D2 a: as received; note the uniform flutes, b: regular machine grooves, no blade irregularities, wear or surface pitting (original magnification a50x & b400x). c: D2 PTU after unfilling of 6 canals, Grain defect (widening of machine grooves) is apparent at the center of instruments' flute, blades shows blunting and irregularities (400x).d: A higher magnification of the previous micrograph; note the irregular blade (arrows) and the disruption and widening of the machine grooves at the flutes' center (800x). e: PTU used in unfilling of 8 canals; marked distraction at the file's second flute was detected (white rectangle) (50x). f: Higher magnification of the previous micrograph: note the severe instruments' distraction (distortion) and cracking, blade blunting and irregularities as well as debris accumulation are also seen (original magnification 400x) .

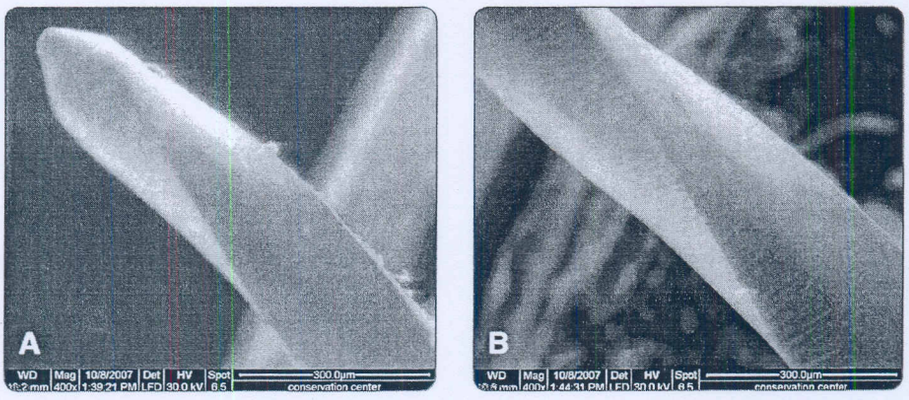


Fig.3: Composite SEM micrograph of a size # D3 PTU instrument's tip and part of the shaft after unfilling of 4 canals. Few debris accumulations were shown near to the instrument's tip (a). (b) revealed starting of features of blade blunting (original magnification 400x)

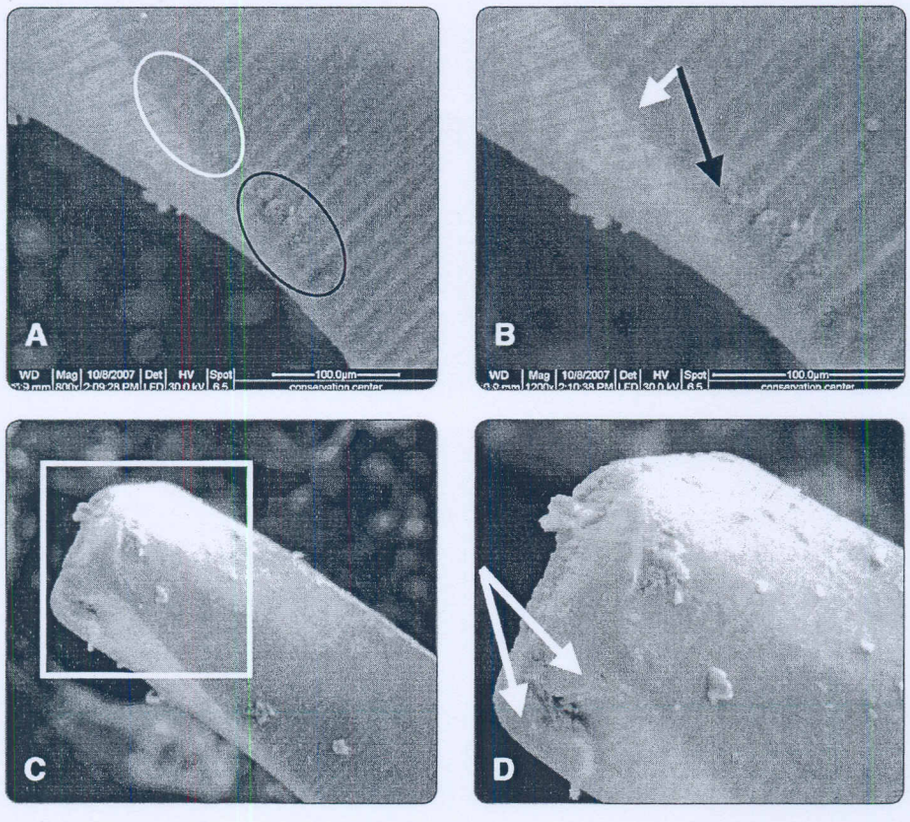


Fig 4 : SEM photomicrographs showing: a: marked irregularities (white circle), wear, and turn over (black circle) of the instrument's blade after 6 canals' unfilling (original magnification 800x). b:A higher magnification of the previous micrograph showing blade wear and irregularities as well as surface pitting (arrows) after 6 canals' unfilling (1200x). c: SEM Micrograph of the PTU files' tip after 8 canals unfilling. Total tip destruction was noted in a D2 instrument. Tip has completely worn and disappeared – not separated- as shown from the alloy turn over (arrows) 400x. d: A higher magnification of the previous micrograph, note the tip disappearance and metal turnover (arrows) (original magnification 800x).

## DISCUSSION

The present investigation was undertaken to evaluate the wear resistance of PTU rotary NiTi retreatment files relative to the number of use. The retreatment files series specified as D1,D2, and D3 were used in unfilling of previously filled canals of premolars teeth. Because it was not the aim of our study to examine canal surface cleanliness after unfilling; we didn't include the rest of Protaper finishing files in the study.

Although concerns and researches about wear resistance and/or deterioration of shaping NiTi files are rife [24-26, 37-40], most of the previous studies on rotary NiTi files designed specifically for retreatment purpose was concentrating principally and solely on canal cleanliness [28,29,36]. Nevertheless, an instrument designed for retreatment is subjected to different types of stresses too (torsion, bending, or surface wear...etc) during performing their tusk.

All studied instruments were inspected as received from the manufacturer for surface quality and imperfections -if present- using a stereo microscope. Examination and inspection were then repeated on the same instruments after being used in unfilling of four, six, and eight canals. Selected representative instruments samples were further examined under an SEM.

The selection of four canals unfilling as the start of examination of used files was to simulate the logic single use of the instrument in unfilling of a molar.

During the research protocol writing, metal strips were proposed as an instrument feature to be examined as declared previously [38, 39]. However, as no metal strips were found in any of the studied instruments either as received or after using in canals' unfilling; so it was found inappropriate to include this feature in the study. On the other hand, absence of metal strips might be a result of the technologic improvement in the manufacturing processes of the PTU rotary retreatment files. Câmara et al. [41] investigated the differences between PT and PTU files and reported that, the geometrical refinement and dimensional differences in the newer version may give rise to favorable clinical behavior.

About one third of the instruments (66.66%) as received were inspected to be free from any microscopically visible defect. P, BB, and BT were detected in 2/30, 5/30, and 3/30 of the investigated instruments respectively. DG as well as MF was not detected in any of the as received instruments. Also MF were absent in all studied instrument after being used in unfilling of 4 canals.

Two thirds of the used instruments showed rapid increase in the visible wear features after unfilling of 4 canals,. One third of the used instruments (33.33%) however, did not reveal any visible defect. On the other hand, all of instruments gradually showed different kinds of visible defect after being used in unfilling of 6 and 8 canals. Generally, highly significant difference were detected between most of tested instrument conditions as compared to the as received (p-value =0.000). Exceptions were MF after unfilling of 4 canals as stated above as well as after unfilling of 6 canals.

Pitting of the blade was found to increase progressively with the increase in the number of unfilled canals. This result was in accordance with Tripi et al [38]. While it conflicted that of Eggert et al [39]. In their study, they evaluated the defects of LightSpeed cutting heads before and after usage using SEM. They found that pitting was the more prevalent defect which decreased after usage.

Comparing wear features in group I (4 canals unfilling) with those of group II (6 canals unfilling), revealed a statistically insignificant increase in all features. This means that the rate of wear reached its highest intensity after unfilling of 4 canals. As compared to group I, group III (8 canals unfilling) instruments showed a statistically significant increase in DG, BB, and MF. While the increase in P