

# E-SEM Evaluation of Root Surface after SRP with Periotor Tips

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*The aim of our study was to investigate the root surface after scaling and root planning (SRP) made with Periotor inserts and contra angle handpiece Profin, comparatively with other two very popular SRP techniques: Gracey curette and ultrasonic piezoelectric scaler with perio-tips. A total number of 30 teeth extracted for periodontal causes were used, 10 teeth for each method of scaling. Samples were examined using ESEM and for each sample micrographs were obtained in four magnifications ( $\times 200 \times 1000 \times 2000 \times 5000$ ). Two examiners blinded to the scaling method but previously trained in evaluating the root surface morphology using RSSL index, examined each micrograph and established a RSSL score. It was considered the highest score for each sample and the average scores were calculated for each group. Lowest scores were obtained by scaling with Periotor inserts followed closely by ultrasonic scaling with perio-tips. Use of Gracey's curettes left the most extensive areas of dentin denudation and in some samples even traces of scratching. In conclusion, our study highlights that using Periotor inserts for root surface scaling the root surface morphology obtained is the most regular and even with fewest dentin denudation areas.*

**Keyword:** Periotor, Gracey's curette, ultrasonic perio-tip, surface morphology, ESEM

Periodontal disease affects irreversibly a large number of individuals. According to the World Health Organization the prevalence of the moderate periodontal disease varies between 2 and 67%, and the severe form between 1 and 79% [1]. Its bacterial etiology, as well as the anatomical peculiarities of the space it evolves give the importance of *scaling and root planning (SRP)* methods. The ability of the fibroblast to adhere to the root surface (which is essential for the periodontal regeneration) depends on the existence of a clean, non-toxic surface, free from bacterial plaque and calculus. Presently, the SRP represents the gold-standard of the periodontal therapy aiming to create a biologically acceptable surface for fibroblasts reattachment. Its efficacy is well documented in systematic [2,3] and narrative reviews [4,5] by the demonstration of gains in clinical attachment levels, reductions in probing pocket depths, and bleeding on probing scores.

There is an intense preoccupation and a growing interest on the development of more advanced instrumental techniques for SRP. Numerous studies have investigated the effectiveness of classical instrumental methods such as SRP with Gracey curette compared with ultrasonic methods. Ultrasonic instruments recently recorded a special development by the emergence on the market of specially designed perio-tips for deep pocket instrumentation up to 10 mm depth. A popular system in many Western countries but still lacking in Romania is the *reciprocating system (Profin®)* with *Periotor inserts*, developed by Axelsson in 1992. The set includes different types of inserts (Tor #1-6), adapted to plane, concave, convex but also to less accessible root areas. The originality and novelty of this system prompted us in our study to compare root surface morphology obtained after SRP with Periotor inserts to that obtained by using Gracey curette and ultrasonic perio-tips.

## Experimental part

### Samples preparation

Thirty human teeth extracted due to periodontal reasons were selected for this study. A standardized procedure was

used to perform the extraction of the teeth. The pliers were applied coronary, without taking any contact with the root surface, in order to maintain untouched the root surface. Before the extraction, the gingival margin was marked on the root surface using a fissure bur at high speed under continuous water cooling. After the extraction, the level of epithelial attachment was also marked using the same procedure. Thus the experimental area used for instrumentation and evaluation was defined between the two marks. The extracted teeth were washed under running water and the periodontal tissue residues were removed using Gracey curette 5/6. The teeth were decontaminated by immersion in 2.5% sodium hypochlorite solution for 15 min and then individually stored in 2 mL of saline at room temperature. After that the teeth were randomly distributed to three groups, according to the method used for root scaling. Each scaling method was performed by one operator, trained and calibrated before the experiment for the specific method. In group 1 the root surface was instrumented using Gracey's curette 5/6 (Hu-Friedy Mfg. Co., Inc.) by applying 20 overlapping working strokes in vertical direction, with a 60-70° working angle and an appropriate pressure during the strokes. In group 2 the root surface was scaled using a periodontal tip mounted on an ultrasonic handpiece (PiezoSmart, Mectron) working at 25 kHz for 15 s (20 strokes) in a vertical direction under abundant water irrigation. In group 3 the root surface scaling was performed using a reciprocating instrument (Profin®) with Periotor inserts (Dentatus Ltd., Sweden) which are mechanically driven with reciprocating strokes of 1.4 mm length.

### Samples evaluation

Evaluation of root surface morphology following SRP using the three methods was made by quantifying the presence of *Root Surface Smear Layer (RSSL)*. All instrumented root surfaces have been evaluated using a new method - Environmental Scanning Electron Microscopy (ESEM) which offers high advantages: the desiccation of the samples is not necessary (this step can

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also generate artefacts, with high risk of errors), nor is the surface coating with gold-palladium, the samples thus being available for further and repeated investigations. This ESEM method, by our knowledge, has not been previously used in the assessment of the treated dental surfaces. The micrographs were assessed by 2 examiners blinded to the experimental procedures but previously instructed during a pilot study to use the following index of *Root Surface and Smear Layer Morphology*, as follows: grade 1 - thick and compact smear layer, no dentin tubules open; grade 2 - thin smear layer, no presence of dentin tubules; grade 3 - residues of smear debris partially occluding dentin tubules; grade 4 - absence of smear layer on the dentin specimen.

All instrumented root surfaces were fixed on aluminum supports and the surface morphology of the uncoated samples was examined using an environmental scanning electron microscope (ESEM) type Quanta 200 (FEI), operating at 20 kV with secondary electrons in low vacuum mode (60 MPa), with a large field detector. Micrographs at four different magnifications ( $\times 200$ ,  $\times 1000$ ,  $\times 2000$ ,  $\times 5000$ ) were recorded for each sample. The micrographs were evaluated by 2 examiners blinded to the experimental procedures but previously instructed during a pilot study to use the following *Index of Root Surface and Smear Layer Morphology characteristics (IRSSLM, shortly RSSL)*, as follows: Grade 1 - thick and compact smear layer, no dentin tubules open; Grade 2 - thin smear layer, no presence of dentin tubules; Grade 3 - residues of smear debris partially occluding dentin tubules; Grade 4 - absence of smear layer on the dentin surface with exposed collagen fibrils. A single value was assigned for each sample after the evaluation of the representative images, resulting in 10 values *per* group and a mean value of the RSSLM was recorded in each group as a result of 10 samples values.

## Results and discussions

Examples of micrographs at four magnifications ( $\times 200$ ,  $\times 1000$ ,  $\times 2000$ ,  $\times 5000$ ) registered for a sample in group 1 (sample a) and a sample in group 2 (sample b) are presented in figure 1.

After the examination of all micrograph at four magnifications ( $\times 200$ ,  $\times 1000$ ,  $\times 2000$ ,  $\times 5000$ ), both examiners decided to use only the micrographs at  $\times 200$  magnification to evaluate the RSSL index due to the fact that at this magnification the entire evaluated area is visible. Examples of the samples micrographs evaluated with grade 1, 2, 3, and 4 according to RSSL index are presented in figure 2 (a, b, c and d respectively).

No large deposits of calculus were seen in all groups. Few calculus remnants were present in few samples of group 1 and 2. The presence of smear layer was noted in all three groups, more often observed in group 1. The ESEM evaluation of the samples also indicated that the surface of the samples of group 3 were smoother than those in group 1 and 2. An example of a sample in group 2 presented distinct scratches as a result of scaling instrument action is presented in figure 3. No irregular surface consisted in depression and elevations were present in group 3.

The total number of the score and the mean values of RSSL recorded for each group are presented in table 1.

Previous studies suggested that more of the root surface removal was obtained by using cures when compare with ultrasonic instruments [6]. This can be explained by the fact that the tip of ultrasonic instruments are thinner than the cutting edge of the hand instruments, in this way causing lesser damages on root surface. In our study the root morphology of many samples after cures action presented distinct and even large area of dentine tubules opening as a result of an aggressive action of the instrument. Even a hand instrument delicately used have the potential to induce scratches and irregularities on the

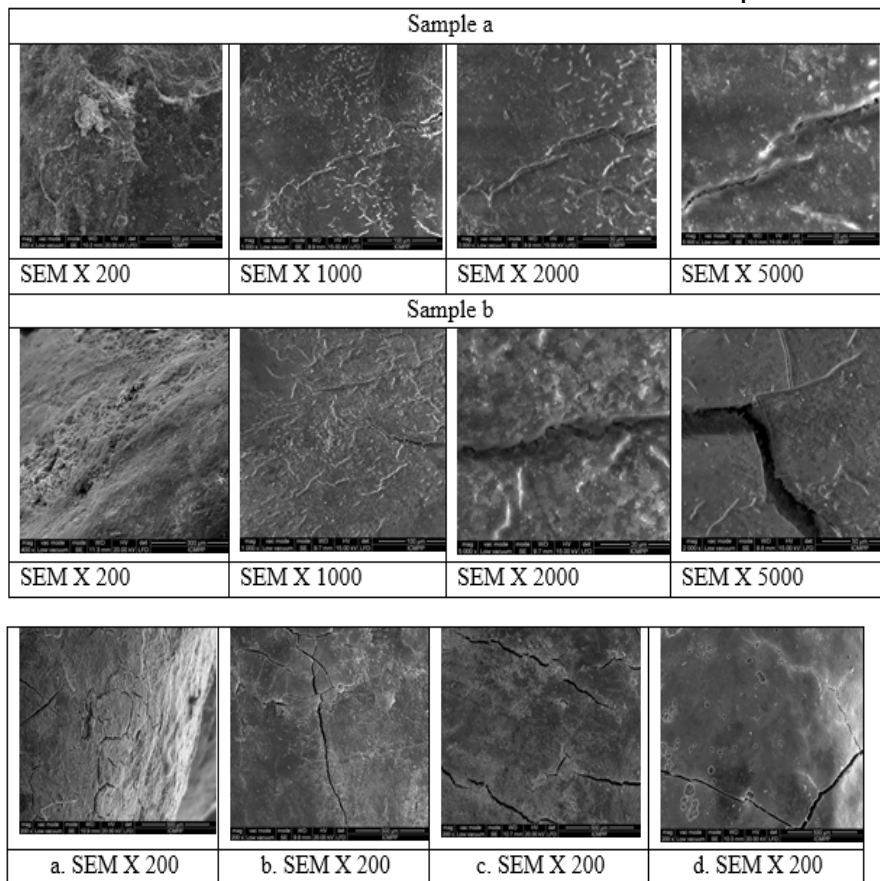


Fig. 2. Samples micrographs evaluated with grade 1, 2, 3, and 4 according to RSSL index

Fig.1. Micrographs at four magnifications registered for a sample in group 1

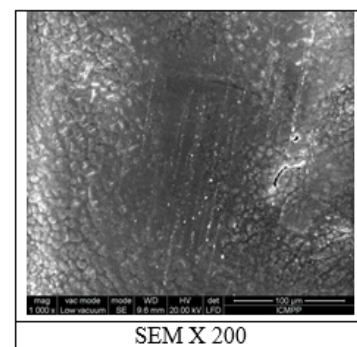


Fig. 3. Micrograph of a sample in group 2 presented distinct scratches

Groups	No.of samples	Total no. of scores				Mean RSSL
		1	2	3	4	
Group 1	10	5	3	2	-	1.7
Group 2	10	1	6	3	-	2.2
Group 3	10	-	4	6	-	2.6

**Table 1**  
TOTAL NUMBER OF THE SCORE AND THE MEAN VALUES OF RSSL INDEX

root surface due to the microscopic roughness of the cutting edge [7]. In this study no distinct tracks of instrument action were observed, probably due to calibrated pressure and to only vertical strokes applied by the operator. Ultrasonic instrumentation created only small irregularities characterized by several pits and partially covered by a thin and porous layer of debris. Also, other study concluded that ultrasonic technique determined the smoothest root surface when comparing the same three methods for SRP according to the surface morphology evaluated using AFM [8].

The presence of the smear layer on the instrumented root surfaces has been shown to act as a physical barrier between the periodontal tissues and the root surface [9, 10] unsuitable for reintegration in periodontal connective tissue [11]. In our study the morphological aspect of root surface when using hand curette revealed a compact smear layer in many samples. The same results were also obtained in other studies [12]. Hand instruments often produce irregular pattern of root morphology, especially when combined horizontal and vertical strokes were applied [13]. More than that, one of our previous study demonstrated that the use of Gracey curettes was the most aggressive method for SRP, led to the highest amount of dental hard tissues lost [14].

### Conclusions

Our study showed that according to the root surface morphology evaluated using the RSSL index on micrographs obtained by environmental scanning electron microscopy (ESEM), the use of Periotor inserts mounted in Profin handpiece created smooth surfaces without organic debris and also without wide denudation of dentine. Almost similar root surface morphology was obtained using the ultrasonic scaling technique with special perio-tips and operating mode specially tuned for access to deep

periodontal pockets up to 10 mm deep. The less quality of root surface morphology, was obtained by using the hand scaling technique with Gracey curette, which led to extensive areas of dentinal tubules denudation and scratches.

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