Evaluation of Different Resharpening Techniques on the Working Edges of Periodontal Scalers: A Scanning Electron Microscopic Study

Hani EL Nahass and Gihane Gharib Madkour

Department of Oral Medicine, Diagnosis and Periodontology, Faculty of Oral and Dental Medicine, Cairo University, Egypt
Nahass77@gmail.com,GihaneMadkour@gmail.com

Abstract: Scaling and root planning contribute to the recovery of periodontal health. All periodontal instruments lose their fine cutting angle after use. To maintain this angle, correct sharpening is required using specifically designed stones. The characteristics of sharpening stones and the sharpening technique will be reflected upon the blade of the instruments. Therefore, the purpose of this study was to evaluate three different sharpening stones and two different sharpening techniques by scanning electron microscope (SEM). **Material and Methods:** Twenty hygienist scaler (Healthco ®) H6/7 were randomly selected and divided into five groups. Each group consisted of four double-ended scalers with eight working edges. Scalers were examined as received from the factory (group I), after dulling (group II) and then after resharpening with either one of three sharpening stones; Arkansas (Hu Friedy®) (group III), India (Hu Friedy®) (group IV) and ceramic stone on power driven sharpener (Hu Friedy Side Kicks®) (group V).The scalers were separated from their stems and photomicrographs of experimental areas were obtained with a SEM (Jeol JXA- 840A, JEOL, Ltd®, Tokyo, Japan).The photomicrographs were then evaluated to obtain the data. **Results and Conclusions:** The instruments sharpened by the manufacturer showed bevels and wire edges indicating the need for every new instrument to be sharpened. Moreover, hand sharpening performed using Arkansas stone (fine grit) produced the best cutting edge followed by India stone (medium grit). Furthermore, power driven device showed the worst results with irregular cutting edges and bevels. We concluded that Arkansas and India stones may be indicated for the routine sharpening of the instruments that are partly dull.

[Hani EL Nahass and Gihane Gharib Madkour. **Evaluation of Different Resharpening Techniques on the Working Edges of Periodontal Scalers: A Scanning Electron Microscopic Study.** *Life Sci J* 2013;10(1):589-593**]**. (ISSN: 1097-8135). http://www.lifesciencesite.com. 94

Key Words: Scanning electron microscopy, scaling, dental instruments, power driven sharpening device, sharpening stones.

1. Introduction:

Treatment of periodontal disease has been traditionally directed toward removal of deposits which are the principal cause of the disease (1). Scaling and root planning (SRP) is considered the most important phase of periodontal therapy (2), thus it has been postulated that high quality cutting edges of periodontal instruments are essential for effective scaling (3-5).Sharp scalers become dull after a few strokes and require frequent resharpening. The edge quality of a scaler is determined by the angle between the two edge forming contiguous surfaces by edges smoothness, by edges sharpness or dullness, and by the presence or absence of metallic projections (wire edges).Wire edges can be classified as functional or non-functional. Functional wire edges extend in the same direction of the cutting stroke while the non-functional wire edges are perpendicular to the cutting stroke (6, 7). Various types of resharpening stones are available. The fine abrasiveness or grit of a natural stone, such as an Arkansas stone, allows a smooth surface and a linear cutting edge. Arkansas stone is usually recommended for sharpening as it is reputed

To produce a better working edge, a smoother surface with a more linear cutting edge (8).On the other hand, Synthetic stones are reported to cause unnecessary metal removal, rough surfaces and wire edges (9).Therefore, it is important to know sharpening techniques, as well as the type of stone that offers more advantages in terms of cutting angle fineness. The development of a more objective description of a good cutting edge was achieved with the aid of scanning electron microscopy (SEM) (10). The purpose of the present study was to evaluate, by SEM, and compare the quality of the cutting edge of periodontal scalers resharpened by different methods.

2. Material and Methods:

Twenty new double-ended hygienist scalers (Healthco ®) H6/7 containing forty stainless steel working edges were randomly selected. Four scalers with eight working edges were examined as received from the factory and were taken as control group (group I). The remaining sixteen scalers with thirty-two working edges were subjected to dulling. Dullness was obtained by scaling a rod containing aluminum oxide (200 µm) for 5 strokes to ensure consistency; the rod was marked to ensure a consistent dulling stroke length. After the similar blunting, four dull instruments were included in group II. The rest of the instruments were resharpened with either one of three sharpening stones, Arkansas (Hu Friedy®) (group III), India (Hu Friedy®) (group IV) and ceramic stone on power driven sharpener (group V). Each group consisted of four scalers with eight working edges. The five studied groups are shown in table 1.

The power driven sharpener (Hu Friedy Side Kicks®) is claimed to be designed to perform routine maintenance sharpening of scalers and curettes. The Sidekick® sharpener has an instrument guide channels and a vertical backstop to help control blade angulation. These "template-like" features allow positioning of scalers/curettes and should provide consistent sharpening results. The power driven sharpener Sidekick® was utilized following the manufacturer's instructions and the utilized stone was a ceramic stone (Hu Friedy®) as delivered by the manufacturer.

For manual sharpening, the technique described by ***Acevedo et al.,*** (11) was applied that entailed the following: The stone was fixed on a table while sliding the instrument on the surface at an angle of 100° to 110°, operating along a 4 cm working length using a similar light force. Force intensity was not measured.

The instruments were sharpened by the same operator applying the same methodology. Sharpening was performed until sharpness was confirmed using plastic test sticks.

Table 1: The characteristics of the five studied groups.

Group I	Control group. Factory sharpening (Healthco®)
Group II	After dulling
Group III	Arkansas sharpening (Fine grit) SS4 Hu Friedy®
Group IV	India stone sharpening (medium grit) SS6 Hu Friedy®
Group V	Power driven (Hu Friedy Side Kicks®) ceramic stone

Each instrument was then cleaned after sharpening by gently shaking it in acetone for 30 seconds and allowed to dry, without any further procedure or contact with the working part of the scaler. Finally, the scalers were separated from their stems and photomicrographs of experimental areas were obtained with a SEM (Jeol JXA- 840A, JEOL, Ltd®, Tokyo, Japan). The photomicrographs were evaluated by a single examiner and classified according to the '*Cutting Edge Index'* developed by ***Acevedo et al.*** **(11)** as follows:

Score 1: A precise angle of the coronal and lateral faces without wire edges.
Score 2: A slightly irregular cutting angle with or without wire edges.
Score 3: A markedly irregular cutting angle with or without wire edges.
Score 4: An undefined cutting angle with presence of a bevel or a third surface.

Statistical Analysis:

Data were presented as mean and standard deviation (SD) values. Scores data are non-parametric data so Kruskal-Wallis test was used to compare between the five groups. This test is the non-parametric alternative to one-way Analysis of Variance (ANOVA). Mann-Whitney U test was used for pair-wise comparison between the groups when Kruskal-Wallis test is significant. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with an IBM® (IBM Corporation, NY, USA) SPSS® (SPSS, Inc., an IBM Company) Statistics Version 20 for Windows.

3. Results:

The different sharpening techniques had significantly different effects on the quality of the sharpness of the working edges (p <0.05). The technique used in group III demonstrated the best results followed by group IV. The worst results were seen in Group V (Table 2 and Figures 1-5). Evaluation of SEM photomicrographs of the studied groups showed the following:

Group I: Factory sharpening showed some defects and functional wire edges. No exact junction between the coronal and lateral faces (bevel) was found, and there were no defects in the cutting angle of the manufacturer sharpened scaler (Figure 1).

Group II: Dulling of the instruments showed bevels, some irregularities and some defects (Figure 2).

Group III: The sharpening technique used in this group produced a precise and clear angle between the faces, creating a defined cutting angle without wire edges (Figure 3).

Group IV: The technique used in this group produced a slightly irregular cutting angle with some functional wire edges (Figure 4).

Group V: The technique used in this group presented an ill-defined cutting angle and bevel formation between the faces (Figure 5).

Table 2: Scores of the studied groups according to the 'Cutting Edge Index'.

Groups	Score1	Score 2	Score 3	Score 4
Group I	5	3	0	0
Group II	0	0	4	4
Group III	6	2	0	0
Group IV	3	4	1	0
Group V	0	2	5	1

The mean and standard deviation values of scores were 1.4 ± 0.5, 3.5 ± 0.5, 1.3 ± 0.5, 1.8 ± 0.7 and 2.9 ± 0.6 for Groups I, II, III, IV and V, respectively (Table3 and Figure 6).There was no statistically significant difference between Group II and V; both showed the statistically significantly highest mean scores. There was no statistically significant difference between Group I, III and IV; all showed the statistically significant lowest mean scores.

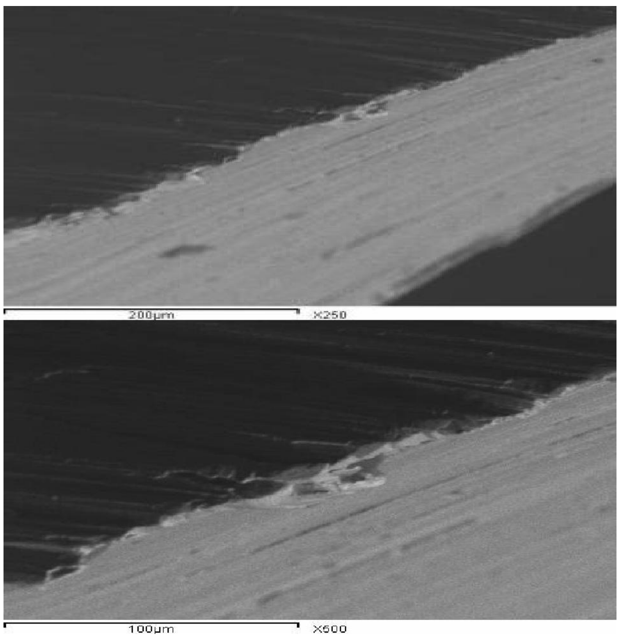

Figure1: Factory sharpening showing functional wire edges (SEM: 250X and 500X).

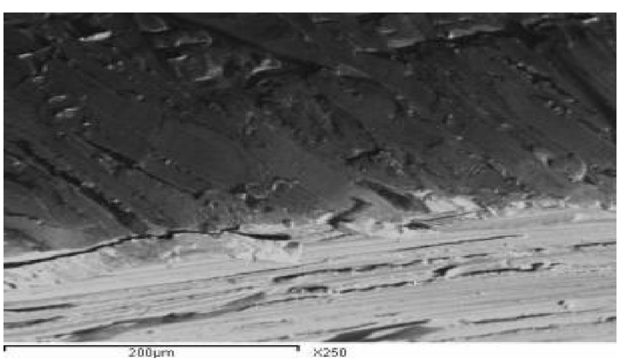

Figure 2: Scaler working edge after dulling showing bevels (SEM: 250X).

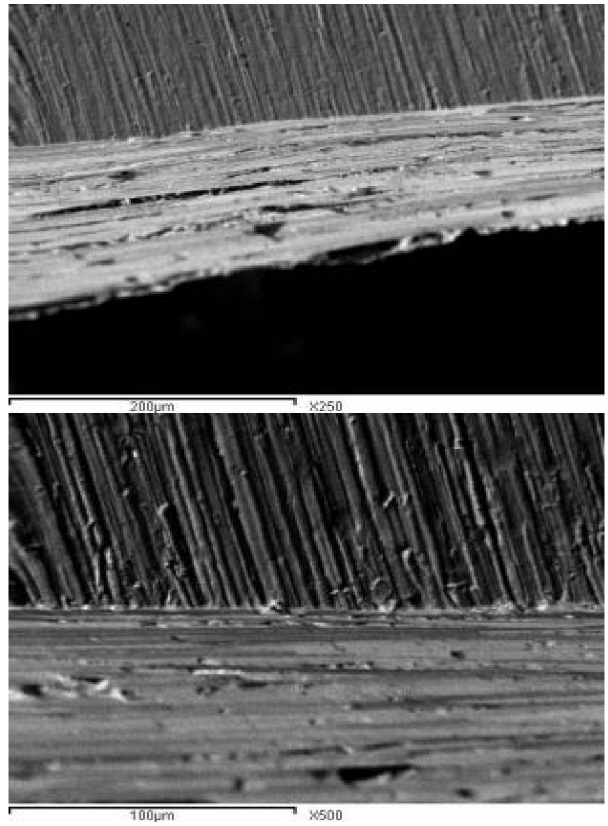

Figure 3: Sharpening after using Arkansas stone showing exact junction between the coronal and lateral faces (SEM: 250X and 500X).

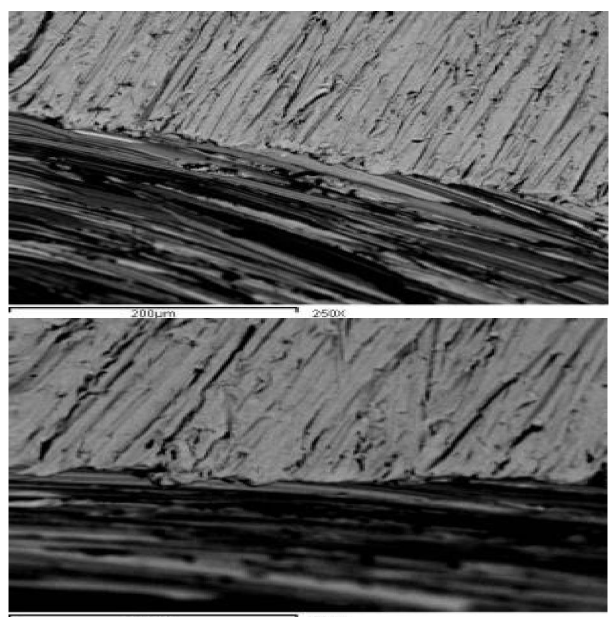

Figure 4: Sharpening using India stone showing functional wire edges (SEM: 250X and SEM 500X).

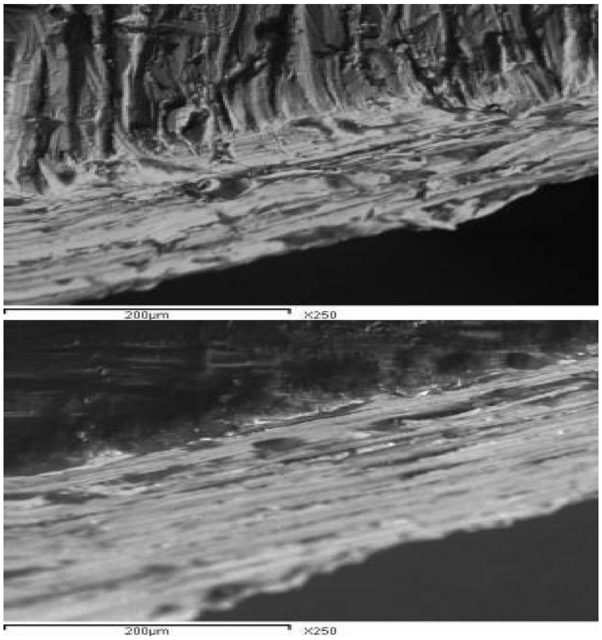

Figure 5: Sharpening using power driven sharpener showed ill-defined cutting angle and bevel formation between the faces (SEM: 250X).

Table 3: The mean and standard deviation (SD) values of scores and results of comparison between the five studied groups.

Groups	Mean	SD	*P*-value
Group I	1.4^{b}	0.5	<0.001*
Group II	3.5^{a}	0.5	
Group III	1.3^{b}	0.5	
Group IV	1.8^{b}	0.7	
Group V	2.9^{a}	0.6	

*: Significant at $P \leq 0.05$, Different letters are statistically significantly different.

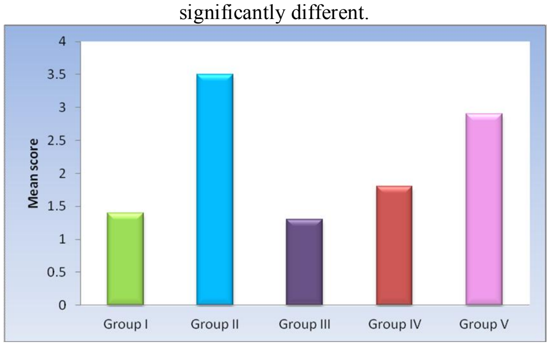

Figure 6: Bar chart representing mean scores in the five studied groups.

4. Discussion

There have been a number of interesting developments in periodontal treatment in the past few years. However, the cornerstone of periodontal treatment remains the mechanical debridement of the crown and the root to remove all mineralized deposits from the tooth surfaces. Therefore, high quality cutting edges on periodontal instruments are indispensable for attaining satisfactory results (3, 10). The importance of the quality of the cutting edge of the periodontal instruments is well recognized (3, 12). After some strokes, all periodontal instruments lose their fine cutting edge and become less efficient (13). A blunt instrument produces a large contact area between the lateral face and the tooth thus decreasing the clearance angle requiring an increase in the operator's hand strength and pressure. Thus, resharpening of the instruments is necessary.

As sharpness cannot be measured in an objective manner, only objective components of sharpness could be measured, i.e. Bevel and presence of wire edges on the cutting edge of the periodontal instrument (14). Several different techniques exist for resharpening of periodontal scalers, each of which will yield a relatively sharp instrument; however, some techniques may decrease the strength of the instrument more rapidly than others. Therefore, the aim of the present study was to evaluate three different sharpening stones and two different sharpening techniques by SEM. In the current study, we compared hand sharpening technique using Arkansas and India stones and one commercially available power driven sharpening device, the Hu Friedy power driven Side Kicks. The evaluation was carried out using SEM with a magnification of 250X and 500X which allowed precise and accurate evaluation of the bevel of the cutting edge and the detection of presence of wire edges (either functional or non-functional).The dulling procedure used in this study was standardized by using the technique described by *Moses et al.*(14) to ensure that all scalers showed similar dulling criteria. The present study used the factory sharpening as the control group (Group I).

In our study, results of SEM revealed that instruments sharpened by the manufacturer showed bevels and wire edges (Figure 1), as confirmed in many previous studies (15-18), indicating the need for every new instrument to be sharpened. Moreover, we found that the sharpening technique used in Group III (Arkansas Hu Friedy) frequently created a precise angle between the cutting edge faces, without wire edges (Figure 3). These results are in agreement with the reports of *Acevedo et al.* (18), *Wehmeyer* (19), *Sampaio and Sampaio* (20) and *Smith* (9). They reported that the Arkansas (Hu-Friedy) stone produced the best cutting edge.

Furthermore, Group IV using the India stone, which is rougher and more abrasive than the Arkansas stone, showed some wire edge projections and produce a more irregular cutting angle. Although wire edges may favor cutting efficiency because their irregularities tend to fracture the deposits, they do not contribute to the creation of a smooth root finishes. Similar findings were described by *Silva et al.* (21).

In contrast to our results, *Huang and Tseng* (16) demonstrated that the sharpening effect of India synthetic stones was the best under SEM examination with a standardized sharpening procedure. Regarding group V which was sharpened using Hu Friedy power driven Side Kicks, results of the present study showed ill-defined cutting angle and bevel formation. This observation could be contributed to the fact that a synthetic stone was used which could produce a less smooth cutting edge when compared to finer stones. In addition, the reciprocating action of the power driven machine could further contribute to the formation of ill-defined cutting edges. The coarser stones and the power driven device can transform a dull instrument into a sharpened one within less time than the fine grit stones. However, it is recommended not to permit an instrument to become completely dull. It is thus recommended to use a fine stone during instrumentation to maintain sharpness, where two or three movements will be sufficient to maintain ideal cutting. The coarse stone can be indicated for initial grinding of totally dull or very deformed instruments, and a fine stone must be used to eliminate the irregularities produced by the coarser one.

5. Conclusions

Within the limitation of this study, the following conclusions can be made:

1. The sharpening technique that employed the movement of the lateral face against the stone (Groups III and IV) provide better cutting angle with either a precise or a slightly irregular angle.
2. Finer stones produced a better cutting edge with less wire edges when compared to coarser stones.
3. Power driven sharpening device demonstrated a high incidence of extremely irregular cutting angles or the formation of bevels.

References

1. Jones WA, O'Leary Tj: The effectiveness of *in vivo* root planning in removing bacterial endotoxin from the roots of periodontally involved teeth. J Periodntol; 49; 377-342: 1978.
2. Ciancio S: Non-surgical treatment. In: World Workshop in Clinical Periodontics, 1989. Chicago: Princeton. Proceedings of the American Academy of Periodontics; p. 15- 16, 1989.
3. Paquette OE and Levin MP: The sharpening of scaling instrument: An examination of principles. J Periodontol; 48: 163, 1977.
4. Ewen SJ and Gwinnett AJ: A scanning electron microscopic study of teeth following periodontal instrumentation. J Periodontol; 48:92-97: 1977
5. Cobb CM: Clinical significance of non-surgical periodontal therapy: an evidence-based perspective of scaling and root planning. J Clin Periodontol; (29):6-16:2002.
6. Allen DL, McFall WT, and Hunter GC: Periodontics for the Dental Hygiensit, 2nd ed. Philadelphia, PA: Lea Febiger, 1974.
7. Tal H, Kozlovsky A, Green E and Gabbay M: Scanning Electron microscope evaluation of wear of stainless steel and high carbon steel curettes. J Periodontol; (45) 320-324, 1989.
8. Wilkins EM: Clinical Practice of Dental Hygienist, 3rd edition, p 186. Philadelphia, Lea Febiger, 1971.
9. Smith BA, Setter MS, Caffesse RG and Bye FL: The effect of sharpening stones upon curette surface roughness. Quintessence Int; 18:603-613. 1987.
10. Antonini CJ, Brady JM, Levin MP and Garcia WL: Scanning electron microscope study of scalers. J Periodontol; (48):45-48: 1977.
11. Andrade Acevedo RA, Sampaio JEC and Shibli JA: Scanning Electron Microscope Assessment of several Resharpening Techniques on the Cutting Edges of Gracey Curettes. J Contemp Dent Pract; (8)7:070-077, 2007.
12. Biller IR and Karlsson UL: SEM of curette edges. Dent Hyg; 53:549-554:1979.
13. Pattison GL, Pattison AM: Principles of sharpening. In: Periodontal instrumentation. Clinical guidance. Pattison GL, Pattison AM (editors). São Paulo: Editorial Médica Panamericana; p. 263-283, 1996.
14. Moses O, Tal H, Artzi Z, Sperling A, Zohar R and Nemcovsky CE: Scanning electron microscope evaluation of two methods of resharpening periodontal curettes: A comparative study. J Periodontol; 74:1032-1037, 2003.
15. Hoffman LA, Gross KB, Cobb CM, Pippin DJ, Tira DE and Overman PR: Assessment of curette sharpness. J Dent Hyg; 63:382-387, 1989.
16. Huang CC and Tseng CC: Effect of different sharpening stones on periodontal curettes evaluated by scanning electron microscopy. J Formos Med Assoc; 90(8):782-7: 1991.
17. Rossi R and Smukler H: Scanning electron microscope study comparing the effectiveness of different types of sharpening stones and curettes. J Periodontol; 66:956-961:1995.
18. Andrade Acevedo RA, Cardozo AKV and Sampaio JEC: SEM and profilometer study of sharp stones. Scanning Electron Microscopic and Profilometric Study of Different Sharpening Stones. Braz Dent J; 17(3): 237-242, 2006.
19. Wehmeyer TE: Chair side instrument sharpening. Quintessence Int; 18: 615-617, 1987.
20. Sampaio LM andSampaio JE: Effect of root surface polishing after manual instrumentation. SEM analysis. Periodontia; 7:163-168, 1998.
21. Silva MV, Gomes DA, Leite FR, Sampaio JE,de Toledo BE and Mendes AJ: Sharpening of periodontal instruments with different sharpening stones and its influence upon root debridement-scanning electronic microscopy assessment. J Int Acad Periodontol.; 8(1):17-22, 2006.

12/20/2012