Analysis of Manual Sharpening Method Towards the Cutting Edge Index of Sickle Scaler Instrument

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Abstract

Introduction: Cutting edge sharpness of the periodontal sickle scaler instrument will become blunt after several times of usage; thus the sharpening will be required to maintain the instrument's sharpness of the instrument. Based on the method used, manual sharpening using a whetstone can be divided into a moving instrument technique and moving stone technique. The purpose of this study was to analyze the cutting edge index of a sickle scaler instrument after being sharpened with two different techniques using an electron microscope / SEM. **Materials and Methods:** Thirty-two new sickle scaler instruments of type H15 / 33 (Oshung Inc.) were randomly selected and divided into four groups. The scaler instrument originated from the factory was becoming a positive control (Group I); the instrument that has been blunted was becoming a negative control (Group II). The other groups were the blunt sickle scaler that sharpened using the moving stone technique (Group III) and the moving instrument technique (Group IV). The cutting edge index of all instruments was then analyzed using SEM (JSM 6360LA, JEOL Ltd, Tokyo, Japan). The cutting edge index data from the photomicrograph was then processed using the Kruskal-Wallis and the Mann-Whitney statistical tests. **Result:** The results showed a significant difference in the sharpness level between the manual sharpening groups; this can be seen from the p-value = 0,000 (p-value < 0.05). The average cutting edge index value showed the best results in the moving instrument sharpening technique (2.10), followed by the moving stone sharpening technique (3.10). **Conclusion:** A periodic sharpening of sickle scaler instruments using a moving instrument technique provides a finer and sharper cutting edge level than the moving stone technique.

Keywords: *Manual sharpening, Cutting Edge Index, Sickle scaler instrument.*

Introduction

The use of sharp periodontal instruments will facilitate the process of removing calculus, increase the tactile sensitivity, reduce repetitive movements, a smoother root surface, and allow the operators to work more precisely and efficiently.[1,2]

The cutting edge sharpness of the periodontal instrument will become blunt after several times of usage thus requires a sharpening to maintain the sharpness and the instrument's original shape. The research conducted by Tal et al. showed that after 45 stroke movements, 95% of the stainless steel periodontal instrument cutting edge would deform and blunt.[3,4]

The cutting edge of a sickle scaler instrument is a line formed from the confluence of the coronal and the lateral side of the blade located on the working edge of the instrument. The purpose of sharpening the instrument is to restore the blunt edge to become smooth and sharp again.[5,6]

Based on the method used, the manual sharpening technique with whetstone divided into two different techniques. The first technique is the moving stone technique and the second technique is the moving instrument technique. The moving stone technique is a technique in which the instrument is held in a stationary position, then the whetstone is moved on the lateral side of the instrument's cutting edge; while in the moving instrument technique, the whetstone is held in a stationary position, then the lateral side of the instrument's cutting edge is moved horizontally facing the whetstone.[5]

The purpose of this study was to analyze the cutting edge index of a sickle scaler instrument after being sharpened with two different techniques using an electron microscope / SEM.

Materials and Methods

In this study, as much as thirty-two sickle scaler instruments of type H15 / 33 (Oshung Inc.) were prepared and divided into four groups. Eight instruments were randomly chosen to be included in the positive control group (Group I), which was a group of scaler instruments originated from the factory, without treatment, and the cutting edge's sharpness was observed.

Another twenty-four samples were then blunted using the scaling strokes on a cylinder coated with aluminum oxide (2400 Micron) for 5 cm in 5 movements. The collection process was performed on a digital scale with an average pressure of 11 KN. Eight blunt instruments were then chosen randomly to be included in the negative control group (Group II), which was a group of blunt scaler instrument group that will not be sharpened.

The remaining sixteen blunt instruments were then divided into two treatment groups; eight instruments were sharpened using the moving stone technique (Group III); eight instruments were sharpened using the moving instrument technique (Group IV). All four research groups are described in Table 1.

Table 1. Characteristics of the four samples groups in this studies

Group	
Group I	Positive control. Originally sharpened from the factory (Oshung Inc.)
Group II	A negative control, Blunted instruments
Group III	Manually sharpened with moving stone technique
Group IV	Manually sharpened with moving instrument technique

The sharpening procedure by the moving stone technique (Group III) was performed using a sickle scaler instrument held on the left hand with palm and thumb grasp. Afterward, the Ceramic and Arkansas whetstones were adapted to the lateral side of the instrument by forming an angle of 70-80 degrees. Sharpening starts from the heel third, continued to the middle third and the tip third by moving the whetstone with an average pressure of 7 KN towards the vertical direction with an 8 cm sharpening distance of 10 times and ended with moving down direction.[5]

Manual sharpening with the moving instrument technique in group IV was carried out by placing an Arkansas or ceramic whetstone on a Sharpening Horse to produce a slope of around 70-80 degrees angle with the coronal side of the instrument. Sharpening begins by moving the instrument's lateral side 10 times horizontally with a pressure of 11 KN and sharpening distance of 8 cm along with the fulcrum finger movement starting from the heel third continued to the middle third and ended in the tip third. [5,6] (Figure 1).

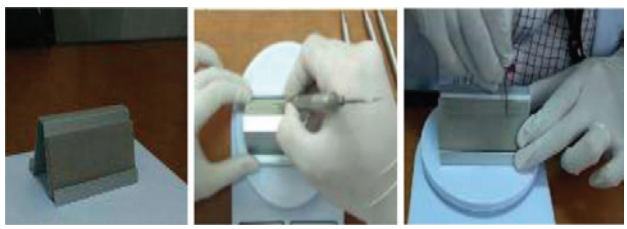

Figure 1. Sharpening horse tool (left image) and sickle scaler sharpening with moving instrument technique; the stone was fixed on sharperning horse tool while sliding the lateral surface of the instrument at an angle 70-80º (right image)

The whole sample was then cut on the working-end side to be observed in the area of 1-2 mm from the tip of the instrument using an SEM microscope. The results of SEM observations in the form of photomicrograph

were then evaluated and classified by one independent examiner using the *Cutting Edge Index* as found by Acevedo et al.with the following conditions:

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 the presence of a bevel or a third surface.[7]

Statistic Analysis

All data in this study were presented in the form of average values and standard deviation values (SD). The Kruskal Wallis analysis was used to test the data presented and checked whether there were significant differences between the groups sharpened with the moving stone technique and the moving instrument technique. Significant level was set at the p-value < 0.05. The Mann Whitney analysis was conducted in advance to test the comparison between groups if the Kruskal Wallis analysis showed a significant difference. Statistical analysis was performed using the IBM SPSS Version 2.0. for Windows software.

Result

The results of this study indicated a significant difference in the sharpness levels between all manual sharpening groups; this can be seen from the p-value < 0.05. The moving instrument sharpening technique group (group IV) showed a better value compared to the moving stone sharpening technique group (group III). The results of the cutting edge index assessment are shown in Table II. Photomicrograph evaluation of SEM analysis in each study group showed the following results:

Table 2. Score studied groups according to the "cutting edge index". The Mean Score of Moving Instrument Technique showed a better value* than the Moving Stone Technique group. *lower score is better

Group	Score 1	Score 2	Score 3	Score 4	Average
(I) Control +	4	4	-	-	1.5 ± 0.6
(II) Control -	-	-	-	8	4.0 ± 0.0
(III) MST	-	1	5	2	3.1 ± 0.6
(IV) MIT	1	5	2	-	2.1 ± 0.6

Group I: In the positive control group can be seen that the group of sickle scaler instruments originated from the factory was not having a perfect cutting edge wholely. Some samples showed mild defects in the intersection areas of the lateral and coronal sides (Figure 2 Left).

Group II: In the negative control group, the group of instruments that have been blunted showed a clear bevel view and a severe defect on the cutting edge area. (Figure Figure 2 Right).

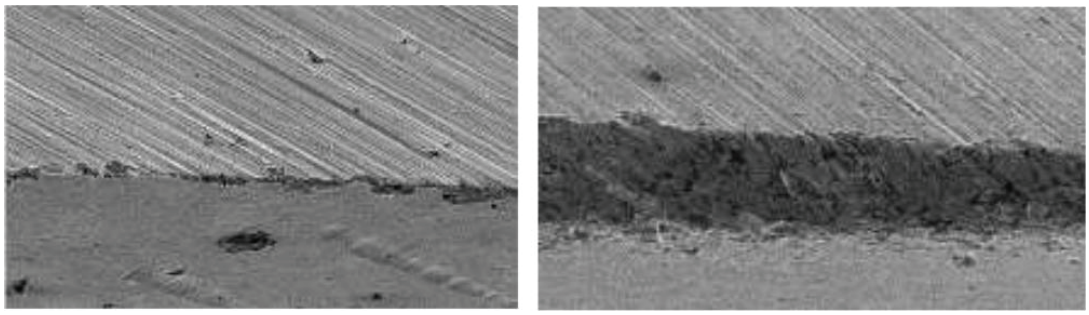

Figure 2. A visible view of a mild defect on an instrument originated from the factory showed by arrows (Left). A visible bevel view in the group of instruments that have been blunted indicated by arrow (Right) *SEM 300X

Group III: Manual sharpening with the moving stone technique provided an irregular cutting edge view with a larger defect in the lateral and coronal sides. The bevel formation, however, was no longer visible (Figure 3 Left).

Group IV: Manual sharpening with the moving instrument technique provided a smooth cutting edge view, as seen from the photomicrograph, accompanied by the presence of lightweight, functional wire edges. The bevel view was completely clear (Figure 3 Right).

Figure 3. Group III showed a slightly irregular cutting edge with a mild defect showed by arrows. (Right) Group IV showed a smooth cutting edge view accompanied by the presence of lightweight, functional wire edges *SEM 300X

The average value and standard deviation of each group in this study were 1.5 ± 0.6, 4.0 ± 0.0, 3.1 ± 0.6, 2.1 ± 0.6, respectively, for the group I, II, III and IV. The Kruskal-Wallis analysis was used to test whether there were significant differences between groups sharpened with the moving stone technique and the moving instrument technique.

The calculation results of the Kruskal-Wallis test (Table 3) showed a significant difference in the level of sharpness between treatment groups; this can be seen from the p-value = 0.001; where this value was below 0.05. The Mann-Whitney test showed that the least significant group difference with the positive control group was group IV, which was sharpened using the moving instrument technique (p-value > 0.05).

Table 3. Mann-Whitney Advanced Test based on the Sharpening Technique showed that the least significant group difference with the positive control group was group IV (MIT) (p-value > 0.05).

Group	A	B		C	D
I	-	0.013		0.008	0.126
II	0.013	-		0.023	0.004
III	0.008	0.023		-	0.011
IV	0.126	0.004		0.011	-

Notes: A = Positive control; B = Negative control; C = Moving stones technique; D = Moving Instrument Technique

Discussion

Effective and efficient periodontal therapy will be difficult to achieved using a blunt cutting edge instrument. Instruments with sharp cutting edges will cut more precisely and quickly compared to blunt instruments. The use of blunt instruments will reduce the tactile sensitivity of the operator, and increase the trauma risk caused by the instrument due to the use of excessive energy at the time of instrumentation.[5,8,9]

The sharpness of the periodontal instrument cutting edge will be degraded after some times thus requires re-sharpening to maintain the sharpness and original instrument shape. The research conducted by Tal et al. showed that after 45 stroke movements, 95% of stainless steel periodontal instruments would deform so that the cutting edge will become blunt. Other studies also showed that periodontal instruments would lose the metal structure and required sharpening after 15-40 times stroke movements used during calculus removal.[3,4]

The purpose of instrument sharpening is to restore the blunt cutting edge to become smooth and sharp again. This condition can be obtained by sharpening the blade until the junctional area of the coronal and lateral sides then returns to form a straight line, not in a circular movement.[1,5,6]

The purpose of this study was to determine the differences in the sharpness level of the sickle scaler instrument cutting edge after sharpened using two different manual sharpening methods, namely the moving instrument technique and the moving stone technique, each using the fine grit Arkansas and ceramic stones.

In this study, the first group (I) was served as the positive control, which was the group of new sickle scaler instruments originated from the factory then had cutting edge index analysis which provided an average cutting edge index value of 1.5. This value showed that not all the new sickle scaler instruments purchased had a perfect cut line in the cutting edge. This condition was consistent with the study of El Nahass and Madkour in 2007 suggested that the sharpening procedure must be performed to ensure the sharpness of each new instrument's cutting edge.[3]

The second group (II) was served as a negative control, which was the group of sickle scaler instruments that had cutting edge blunted, and had an average cutting edge index score of 4.0. From the photomicrograph, a clear bevel view showed that the scaler instrument had lost its sharpness. The instrument collection process in this study has been standardized with the technique described by Moses et al. to ensure equal treatment of each instrument.[8]

The manual sharpening method using the moving instrument technique in our study provided an average cutting edge index value of 2.10 with the results of sickle scaler's cutting edge sharpness that was better than the moving stone technique method, with an average cutting edge index value of 3.10. This result was consistent with the research conducted by Acevedo et al. in 2007 and Di Fiore et al. in 2015 which stated that sharpening with the moving stone technique showing irregular cutting edges by the presence of wire edges and formations of the bevel or a third surface.[6,7]

In the moving stone technique, although the operator was able to see the sharpening angle formed between the whetstone and the lateral side of the instrument, the operator will find it difficult to maintain the sharpening angle when the stone was being moved up and down as a sharpening stroke. Besides, it was very difficult for the operator to stabilize the instruments held by the non-dominant hand; thus the instrument would appear to move slightly when the rock was moving up and down.[5]

Manual sharpening with the moving instrument technique (Group IV) in this study was standardized with a power of approximately 110 KN to ensure equal treatment of each instrument. Sharpening with this technique was resulting in the average level of sharpness that closed to the positive control group, and the difference between these two groups was not statistically significant.

The use of assistive devices, known as sharpening horse tool in this technique, was proven to be able to facilitate operators in viewing and maintaining the angle between the whetstone and the coronal side of the

instrument. Instruments held by a modified pen grasp on this technique provided precise instrument control and wide movement range. Hand and instrument stabilization can be maximized in the presence of fulcrum or the ring finger support during the sharpening movement.[5,6]

Conclusion

Periodontal instruments such as sickle scaler must have a re-sharpening after the usage, or when they will use in the periodontal instrumentation process. Manual sharpening of the sickle scaler instrument using a moving instrument technique provided a smoother and sharper cutting edge than using a moving stone technique.

Conflict of Interest: Nil

Ethical Clearance: This research has been proved by Health Research Ethics Committee, Universitas Padjajaran, Bandung

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