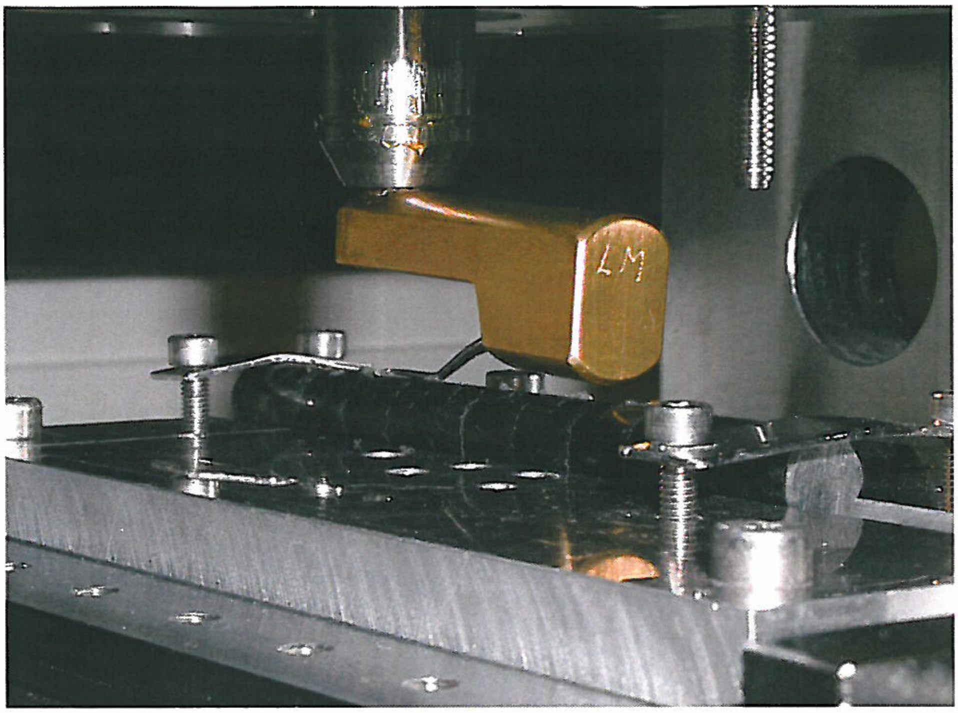

Wear testing of curettes

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Confidentiality Public

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Wear testing of curettes	
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Summary

Wear testing of hand-held dental instruments under normal clinical conditions is problematic since the results and their repeatability inevitably depend on the instrument user as well as the teeth being treated. However, with laboratory testing the most significant factors influencing wear can be standardised and instrument wear can be investigated in a controlled and repeatable way. Curettes from four manufacturers marked as LM, O, HF and AE were tested to compare their wear resistance. The tests were carried out using a specific laboratory test method developed at VTT, with the same procedures, parameters and counterpart materials as has been reported earlier [1]. The wear of the curettes LM, HF and AE was mainly due to plastic deformation, whereas the O curette had worn by abrasion. The wear resistance of the curette O was poor, the samples having clearly the highest wear rate of the curettes tested. The wear resistance of the curettes LM, HF and AE was good and comparable to each other, the samples showing only slight differences in wear land width of the cutting edge.

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Preface

During earlier research VTT has developed a laboratory test method which can be used for testing the wear resistance of dental instruments in a controlled and repeatable way. Curettes from different manufacturers have been received for wear testing from LM-Instruments Oy. The results of the wear tests of curettes from four different manufacturers are reported here.

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Appendix 1. SEM images of the curettes and their cutting edge after the wear test.

1 Introduction

Wear testing of hand-held dental instruments under normal clinical conditions is problematic since the results and their repeatability inevitably depend on the instrument user as well as the teeth being treated. However, with laboratory testing, the most significant factors influencing wear can be standardised and instrument wear can be investigated in a controlled and repeatable way. Wear testing of mesial curettes, used in finishing work in the removal of dental calculus, can be carried out by using the laboratory test developed at VTT [1]. In the test the cutting edge of the curette is positioned and moved against the counterpart material in such a way that the test and the resulting wear simulates the normal dental procedure as close as possible. This also makes it possible to carry out comparative testing of curette wear-resistance. In this report, the wear test results of curettes from four manufacturers are reported.

2 Objective

The objective of the wear testing was to compare the wear resistance of Gracey 11/12 mesial curettes from four manufacturers, marked as LM, O, HF and AE. The AE curette was coated.

3 Wear testing

The tests were performed using VTT's Rectester with the test procedure and parameters described in ref. [1]. The test involves the use of sample holders which have been designed and constructed so that they allow the cutting edge of each curette to be positioned against the counterpart material in such a position that the test simulates the normal dental procedure as close as possible. The counterpart material was ERTALON 66-GF30 fibre-reinforced polyamide from the same production lot as in the earlier tests. The test procedure comprises of a total of 225 strokes, each 5 mm in length, carried out in five-stroke series against the counterpart material. The first 9 stroke series (45 strokes) were performed using the lowest possible load (about 4,9 N), while the remainder of the series were performed using an additional load of 2.5 N, i.e. a total load of about 7.4 N. The lowest possible load in the test depends on the weight of the curette and the respective sample holder and is given in Table 1 below. Two samples of each curette were tested.

Table 1. The lowest possible load for each curette

Curette	The lowest load, N
LM	4.93
O	4.98
HF	4.98
AE	4.94

Wear of the curettes was determined by measuring the average width of the wear land of the cutting edge with scanning electron microscope (SEM) using a magnification of 1000 - 1500 x. The measurements were made on the middle part of the worn edge where the wear was most severe.

4 Results

The results of the wear measurements after the test are given in Table 2. The wear land width of the cutting edge of each curette was measured in SEM at 15 – 20 locations along the most worn area. The wear zone along the cutting edge was somewhat shorter in sample AE2 than in the other samples, and hence the number of measurements was also slightly lower (12). SEM images of one sample of each curette are shown in Appendix 1.

Table 2. Results of the wear measurements.

Sample	Average wear land width, µm	Standard deviation, µm
LM1	17.6	0.6
LM2	18.6	0.8
O1	53.8	1.1
O2	46.0	1.9
HF1	18.7	1.0
HF2	18.5	0.9
AE1	23.0	0.8
AE2	17.9	3.0

SEM examination of the curette samples after wear testing showed that the wear of the curettes LM and HF was mainly due to plastic deformation of the cutting edge. Deformation results in blunting of the cutting edge and detachment of deformed material. Some burred material associated with the deformed edge was still present, but it was not included into the measurement of the wear land width. In the case of the curette AE the coating showed practically no wear but the substrate material at the edge of the curette had deformed slightly resulting to blunting of the cutting edge. The length of this blunted area along the cutting edge was smaller than the length of the worn area in the other curettes. However, the width of the wear land of the blunted area was about the same or slightly bigger than the width of the wear land in the curettes HF and LM. Energy dispersive spectroscopy during the SEM examination showed the coating of the AE curette to be TiN. The wear resistance of the O curette was the lowest of all the curettes tested here and the wear took place by a different mechanism being mainly abrasive in nature.

5 Conclusions

Curettes from four manufacturers marked as LM, O, HF and AE were tested to compare their wear resistance. The wear mechanism of curette O was different from that of the other curettes, being abrasive in nature, whereas the wear of the other curettes was mainly due to plastic deformation of the cutting edge. The wear resistance of curette O was clearly the lowest. The AE curette was TiN coated and, even though the coating itself showed practically no wear, the substrate material had deformed resulting into some blunting of the cutting edge. The wear resistance of the curettes LM, HF and AE was good and comparable to each other, the samples showing only slight differences in wear land width of the cutting edge.

References

1. Helle A. Tutkimus kyrettien kulumiskestävyydestä, Suomen Hammaslääkärilehti (2001) 1-2, s.8-15; Also published as a separate print in English: Helle A. Testing the wear resistance of curettes, The Finnish Dental Journal (2001) 1-2. p.8-15.

Appendix 1. SEM images of the curettes and their cutting edge after the wear test

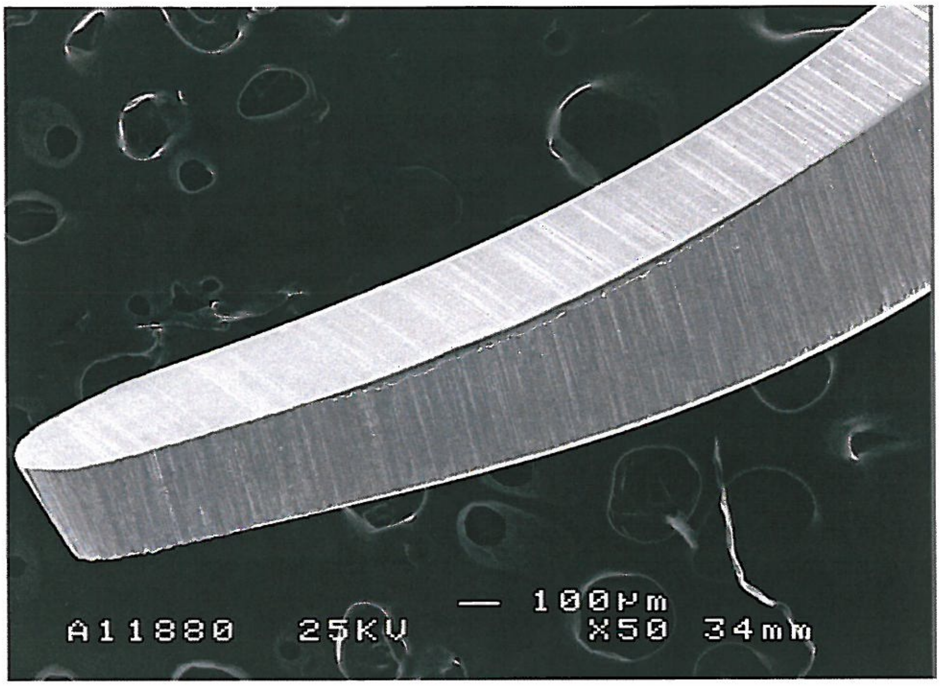

Figure 1.1. SEM image of LM curette after the wear test.

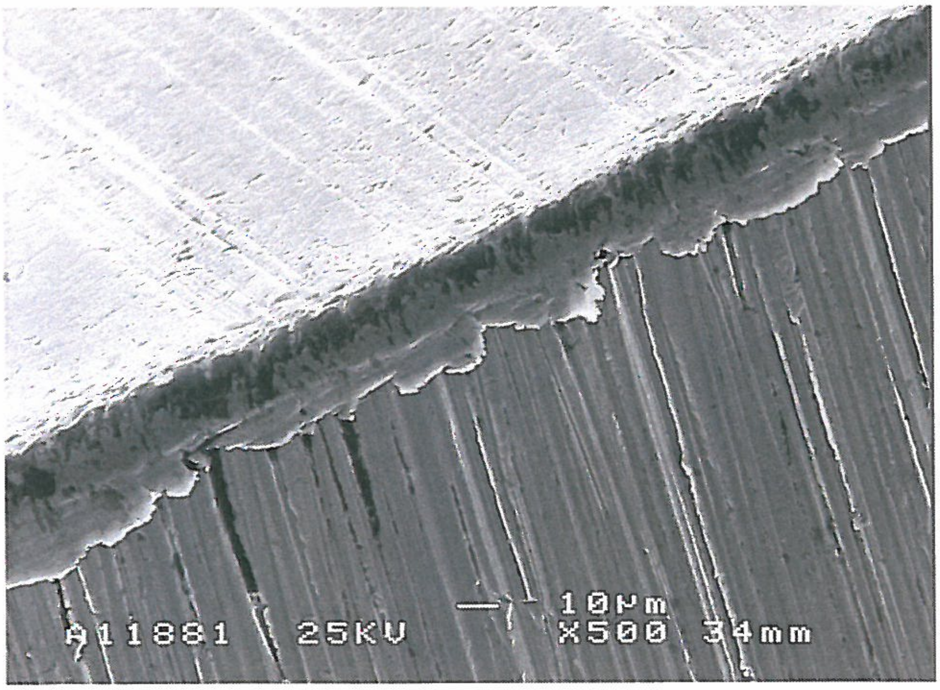

Figure 1.2 SEM image of a detail of the cutting edgeof LM curette after the wear test.

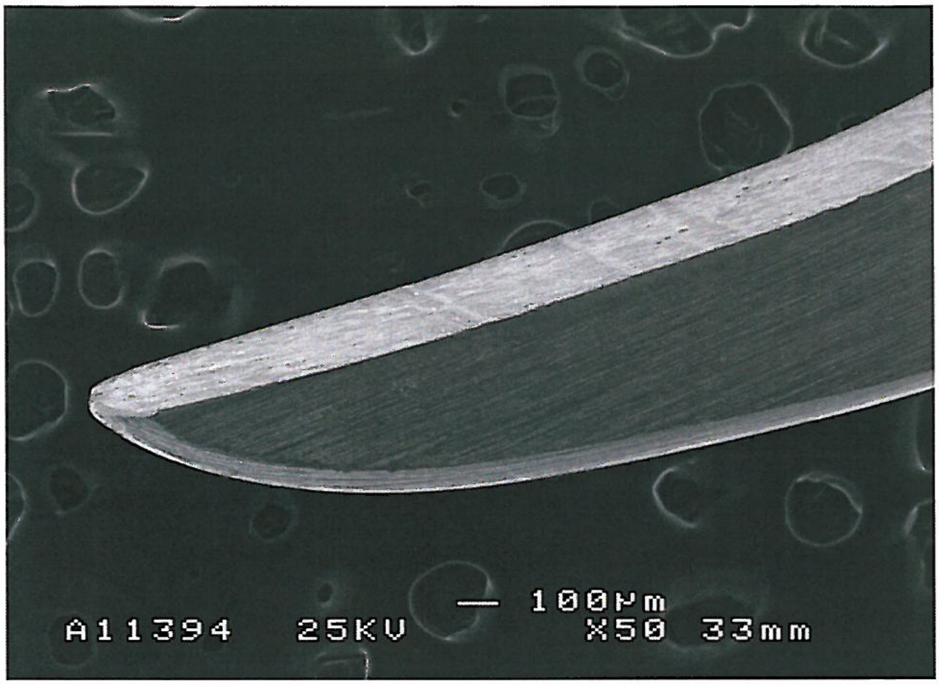

Figure 1.3. SEM image of O curette after the wear test.

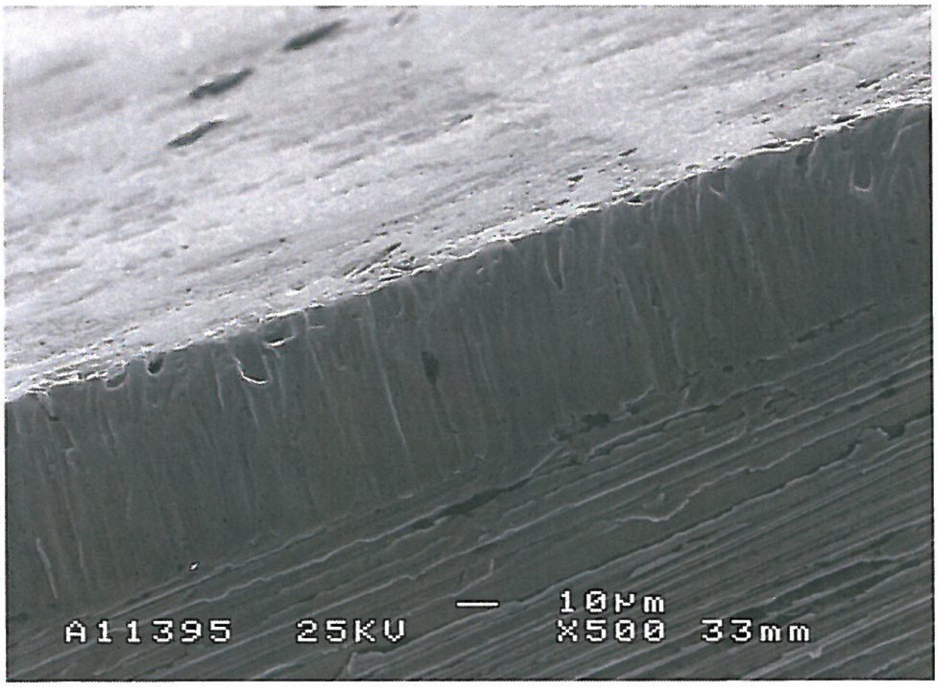

Figure 1.4. SEM image of a detail of the cutting edge of O curette after the wear test.

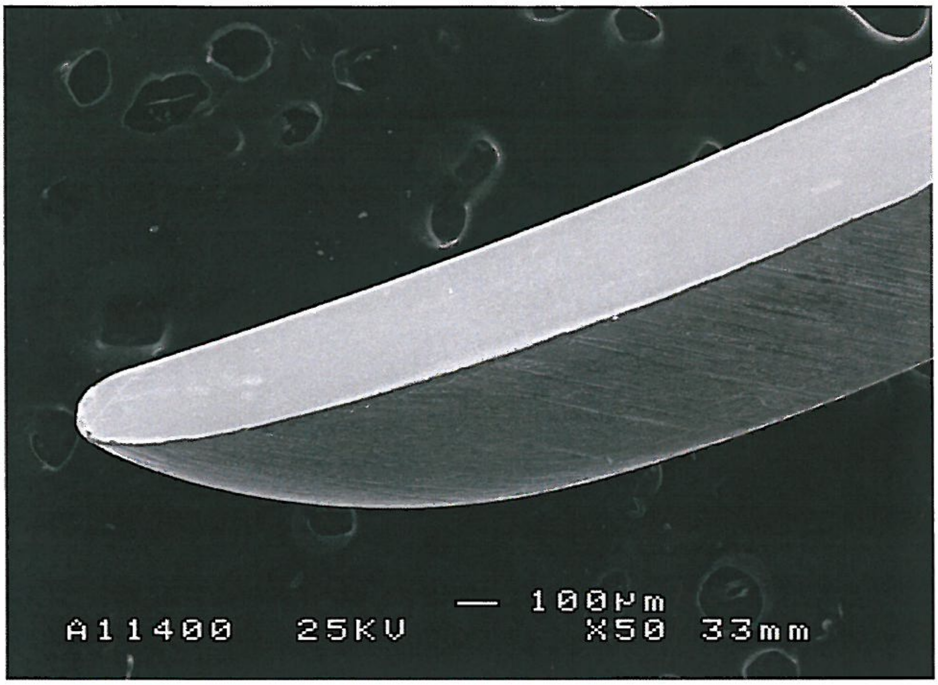

Figure 1.5. SEM image of HF curette after the wear test.

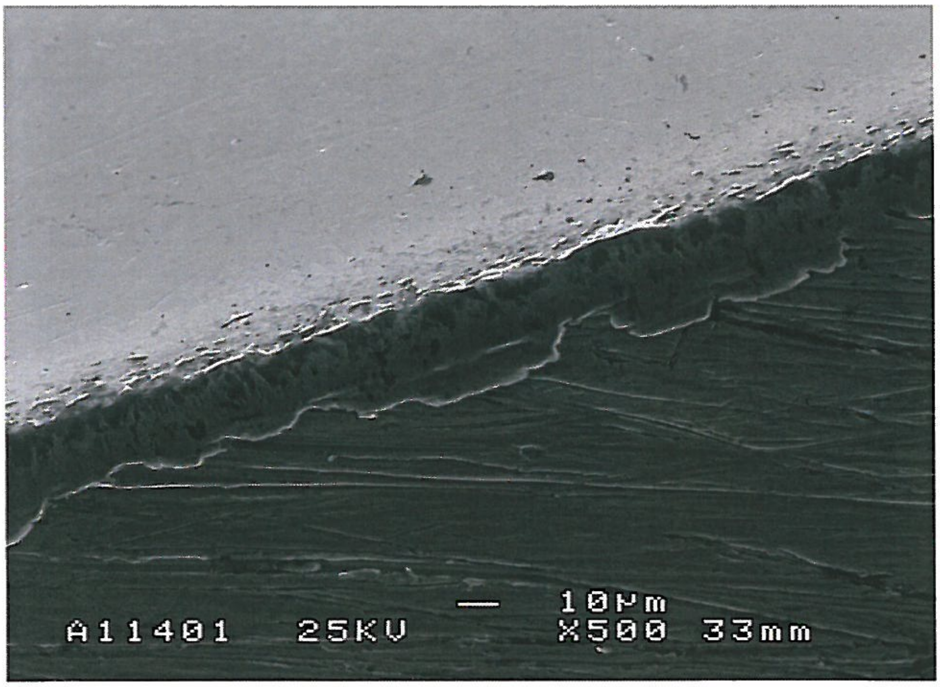

Figure 1.6. SEM image of a detail of the cutting edge of HF curette after the wear test.

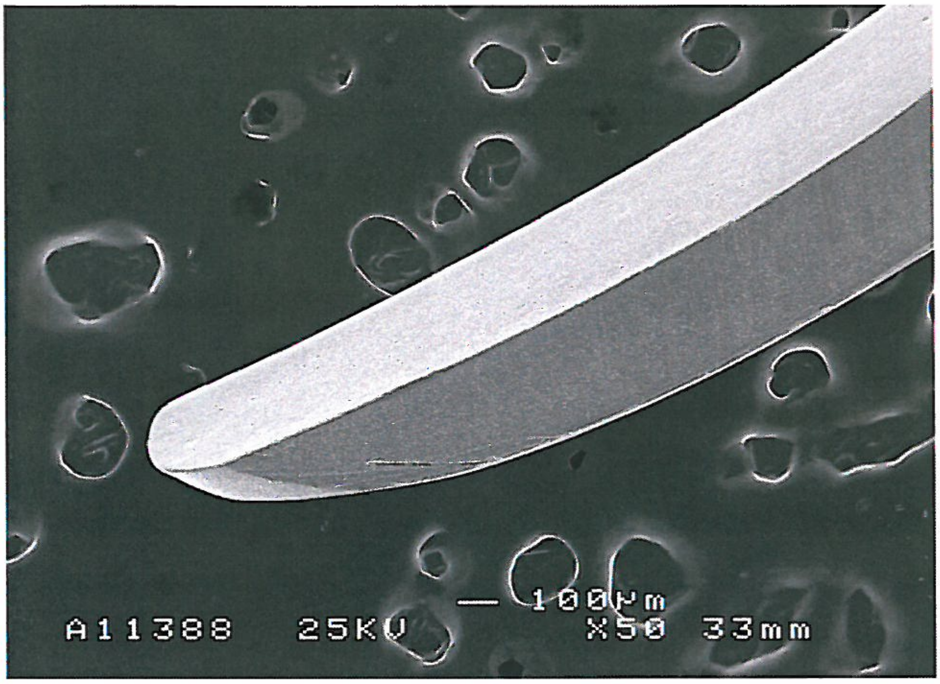

Figure 1.7. SEM image of AE curette after the wear test.

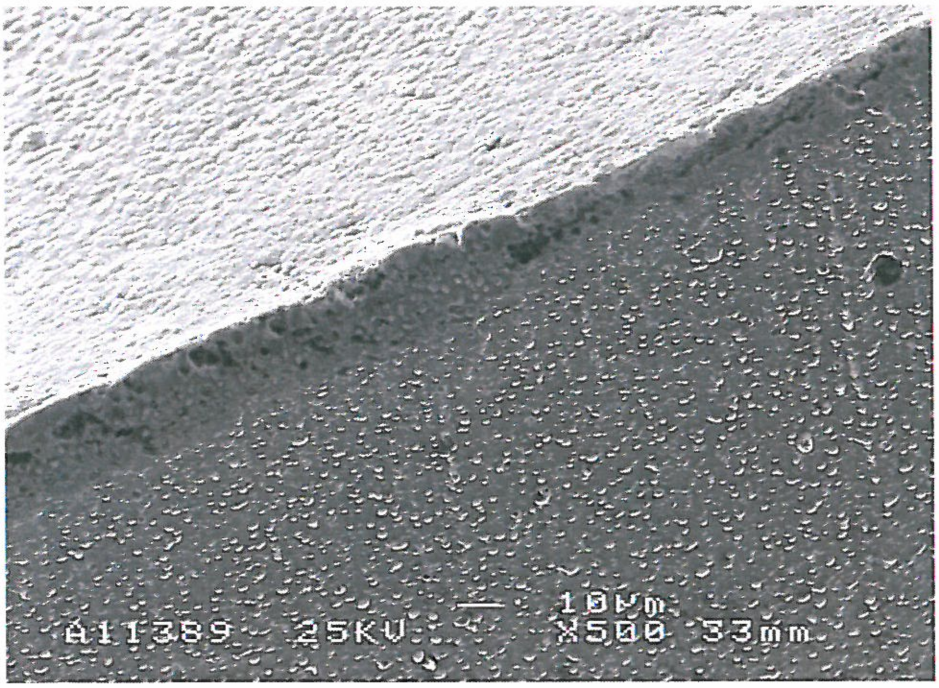

Figure 1.8. SEM image of a detail of the cutting edge of AE curette after the wear test.