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Review Article

The Use of Microscopes at Asahi University: From Introduction to the Present

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The general population is increasingly demanding greater accuracy of treatment and, as part of this, the need for treatments employing dental-use CT and microscopes is growing in recent years. Here, we report on the usage of microscopes at Asahi University Faculty of Dentistry Hospital from their introduction to the present.

In 1998, the American Association of Endodontists began requiring education for American endodontic specialists to include the use of microscopes. Microscopes have been used at this University since a dental use microscope was introduced in 1999. As the potential grew to use microscopes in not only endodontic and periodontic applications, but also conservative dentistry and dentures. Today, five microscopes are used for clinical diagnosis and treatment. The microscopes have also shown their utility in a wide variety of situations outside of diagnosis and treatment. They also enable the monitoring and replaying treatment, meaning that images can be used to obtain patients' informed consent. This makes them a highly useful as a tool for simply yet persuasively communicating with patients. Microscopes also have applications for clinical education for interns at university faculties and hygienist vocational schools and paradental staff.

Using microscopes in treatment enables things that previously could not be seen to be observed clearly. There is no denying that microscopes are an outstanding tool for bringing the level of dental treatment up to the efficient, reliable standards of modern medicine. But, in order to make effective use of microscopes it is essential to use tools that do not obstruct the field of vision, to improve skills through training, and to be proficient with mirror techniques.

Key words: operating microscope, advanced medicine, endodontics, informed consent, clinical education

Prolusion

With the spread of the internet in recent years, it has become easy to obtain information on dentistry from all over the world. The general population is increasingly demanding greater accuracy of treatment and, as part of this, the need for treatments employing dental-use CT and microscopes is growing. Here, we report on the usage of microscopes at this university from their introduction to the present.

Introduction

The introduction of microscopes at this university began in 1999. In 1998, the same year that the American Association of Endodontists began requiring education for American endodontic specialists to include the use of microscopes[1)], three members from the field of conservative dentistry and one member from the field of the periodontology attended a short course of approximately one week as part

Figure 1：First microscope（1999）

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of Professor Syngcuk Kim's Microscope Training in Endodontics program (root canal therapy using dental stereoscopic microscope, lectures and training on endodontic surgery) at the University of Pennsylvania Department of Endodontics. Soon after their return, a Carl Zeiss[2] Opmi111 (figure 1) was purchased in 1999 and set up for operation in the Department of Conservative Dentistry at the university hospital.

Growth and Development

As needs increased, a second microscope was purchased in 2000 (figure 2), and for several years treatment was performed using these two units. In 2006, items on endodontic treatment using microscopes were added to the question criteria for the Japan national dentistry examination. At around the same time, this university commenced an elective course on microscopes as part of the advanced medicine course for interns[3~6].

As the potential grew to use microscopes in not only endodontic and periodontic applications, but also conservative dentistry and dentures, a third microscope was purchased in November of 2008 (figure 3), followed by the introduction of a further two units, which are capable of simultaneously recording still and moving images, in 2009

Figure 2 : Second microscope (2000)

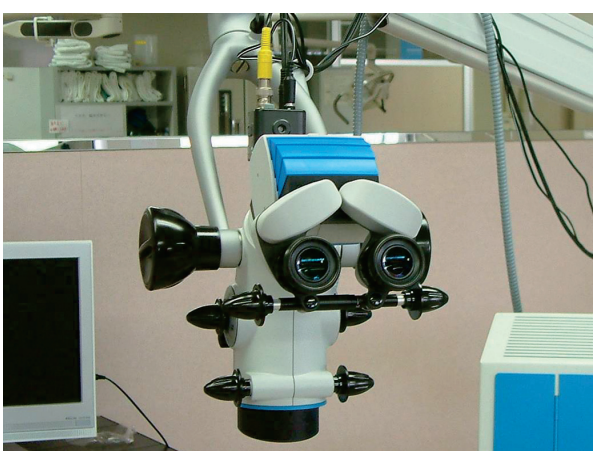


Figure 3 : Third microscope (2008)

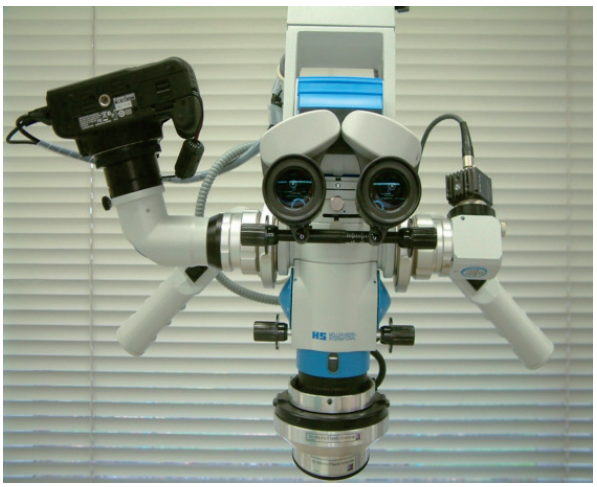


Figure 4 : Fourth and fifth microscopes (2009)

(figure 4). At present, a total of five units are used for treatment. Microscopes enable greater accuracy in clinical diagnosis and treatment[7~17]. They also enable the monitoring and replaying treatment, meaning that images can be used to obtain patients' informed consent. This makes them a highly useful as a tool for simply yet persuasively communicating with patients. Microscopes also have applications for clinical education for interns at university faculties and hygienist vocational schools and paradental staff[18]. It is also possible to use photographs taken under a microscope in university examination questions.

The Concept of Microscopy

There are three main advantages to using microscopes: microscopes enhance vision by enlarging the operative field and ensuring brightness (figure 5); they can be used as a communication tool by sharing vision with patients, staff, and students (figure 6); they can record treatment

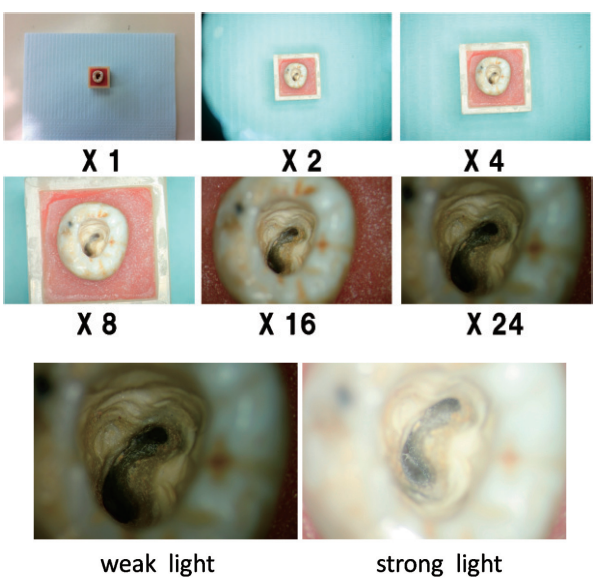


Figure 5 : Magnification levels and strong and weak light sources

Figure 6：Communication tool by sharing vision

with a high-power field using moving and still image recording devices[19] (figure 7). Microscopes are thus able to drastically improve visualization and accuracy, which have long been issues in endodontic treatment.

While enlargement and brightness can also be achieved with a loupe (magnifying glass), the magnification is fixed at somewhere between roughly two and ten times. Microscopes, on the other hand, allow treatment to be performed with magnification of between approximately three to 20 times that can be varied according to the situation (figure 8). With regard to light reaching, because of the congruence between the observation and illumination, even narrow, deep points can be seen brightly (figure 9).

However, caution must be exercised when using a microscope. Although the operator looking into a microscope is able to secure a more detailed and enlarged view, microscopes have drawbacks such as things which would not be missed with an ordinary field of vision, such as a patient's facial expression indicating that they are in pain, become more difficult to see under a microscope because of the very narrow field of vision and it being difficult to perceive distance. Furthermore, because in almost all cases mirror techniques must be used, sufficient training and assistance become very important[20].

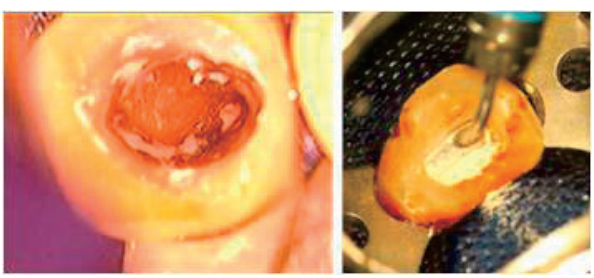


Figure 7：Still and moving images

Loupe　　Microscope

Figure 8：Loupe and Microscope

The equipment used is also an important concept. A number of special tools are required in order to use microscopes effectively in endodontic procedures. Of these, a surface-reflection mirror (figure 10) and a treatment tip attached to an ultrasonic oscillator are essential. When performing treatment under a microscope, a tip that obstructs the field of vision as little as possible should be used (figure 11). A microdebrider is another example of a special tool (figure 12).

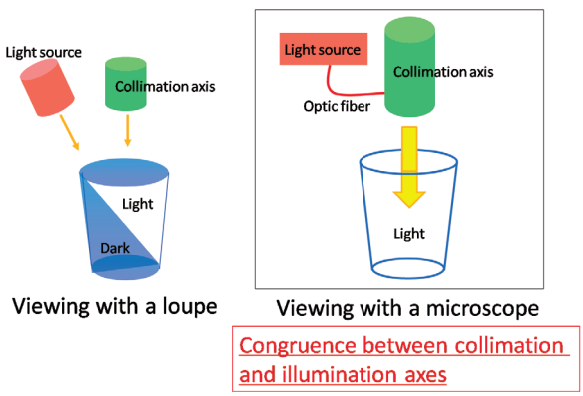


Figure 9：Difference between loupe and microscope with the illumination

Ordinary mirror　　Surface-reflection mirror

Figure 10：Ordinary and Surface-reflection mirror

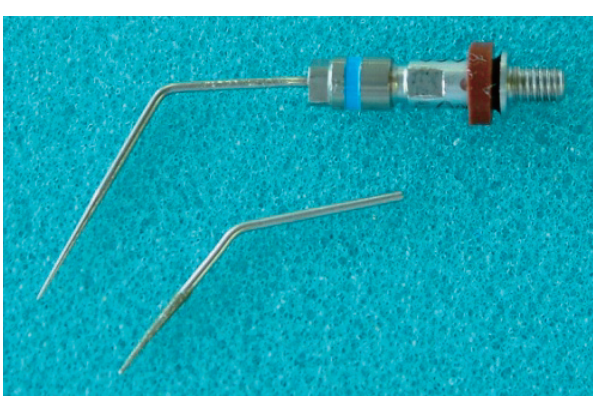


Figure 11：A tip that obstructs the field of vision as little as possible should be used

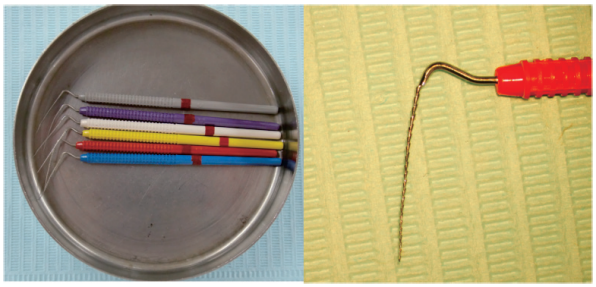
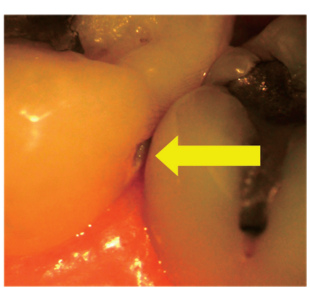


Figure 12：microdebrider

Range of Applications

Microscopes have a wide range of applications. Frequently used for root canal therapy[21~22] (figure 13), they can also be applied to endodontic procedures, periodontal disease, crown restorations, and dentures. Examples include examination of caries and subgingival calculus (figure 14), and margin checks during composite resin restorations (figure 15) and prosthodontic tooth preparations (figure 16).

Figure 13：In root canal treatment



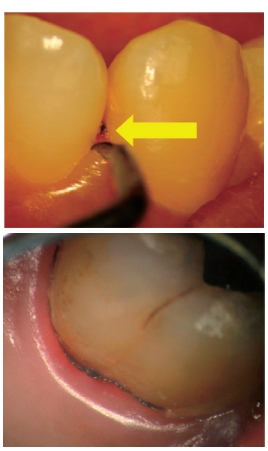


Figure 14：Carious cavity　Dental calculus (Tartar)

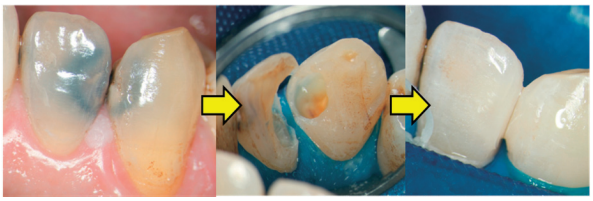


Figure 15：CR restoration

Figure 16：Margin check

Case

Next, we will discuss usage in an actual case. When used to examine teeth, microscopes are effective for checking for secondary caries around dental restorations, margin checks on dentures (figure 17), and discovering cracks (figure 18). When performing dental pulp extraction root canals, excessive cutting can be avoided by using a microscope to confirm the shape of the pulp cavity (figure 19).

Microscopes are effective for checking openings of narrow sections such as the isthmus and fins (figure 20), checking and removing calcification, which can cause dental pulp calcification and closure or narrowing of the root canal (figure 21), exploring the structure of the floor of the pulp chamber of the medullary canal, which can cause furcation involvement (figure 22), and, in subsequent explora-

Figure 17：Examination of secondary caries

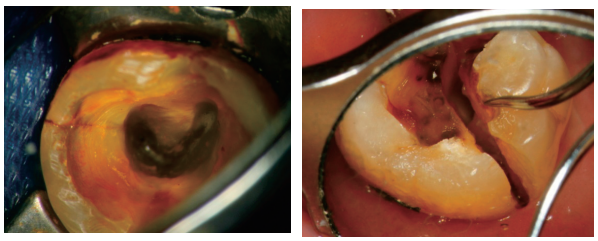


Figure 18：Crack　Fracture

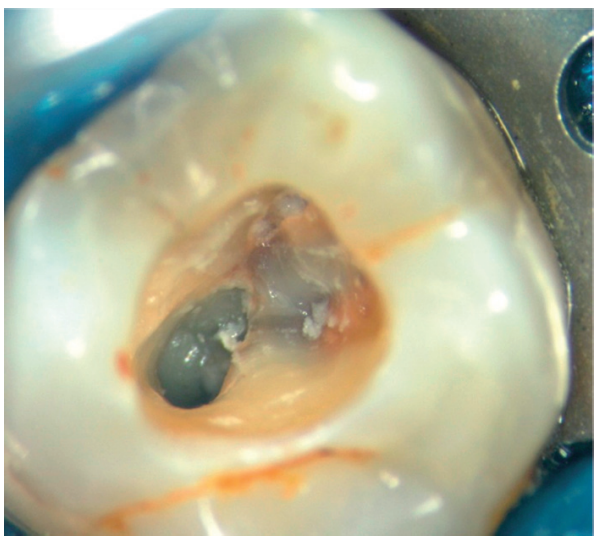


Figure 19：Checking inside the pulp cavity opening

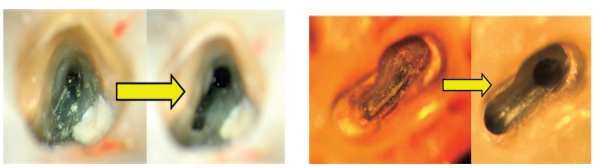


Figure 20：Openings of narrow sections

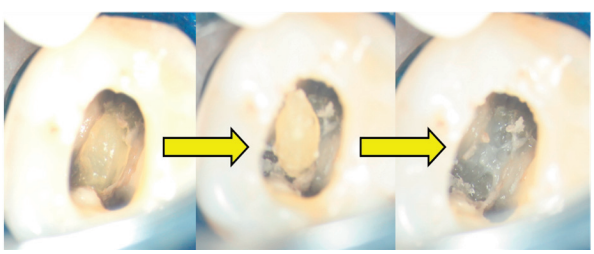


Figure 21：Checking and removing calcification

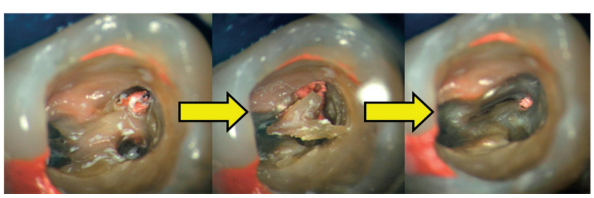


Figure 22：Removing calcification and checking the floor of the pulp chamber

tion of root canals, discovery and treatment of fourth root canals and other overlooked root canals, narrow root canals, and unusually shaped root canals. For treating infected root canals, microscopes can be used for confirming the removal of root canal filling material and searching for the main root canal (figure 23), root canal enlargement of gutter-shaped roots (figure 24), perforation repairs (figure 25), removing broken tools (figure26), and endodontic surgeries[23–28] (figure 27).

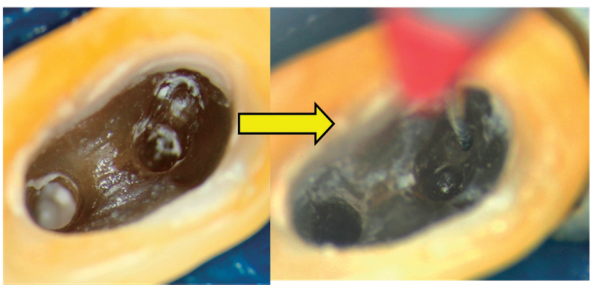


Figure 23：Discovery of original root canal after removal of metal core and root canal filling material

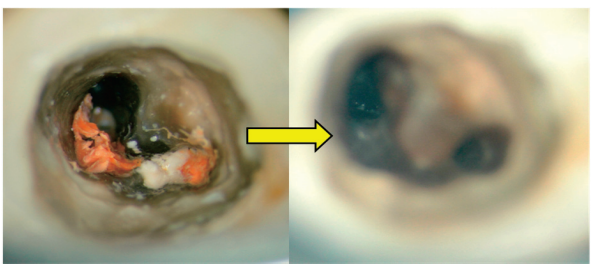


Figure 24：Gutter-shaped root

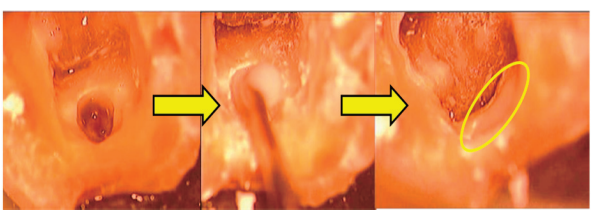


Figure 25：Perforation repair

Figure 26：Removal of broken tool

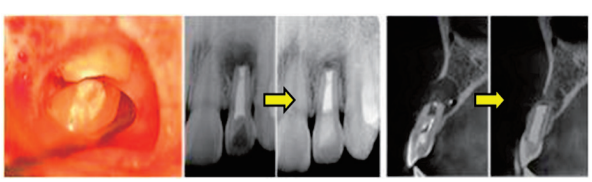


Figure 27：Endodontic surgery (micro-surgery)
Checking the periapical with a retro mirror during an operation
Post-surgical monitoring with dental and cone beam CT

Future Issues

Using microscopes in treatment enables things that previously could not be seen to be observed clearly. There is no denying that microscopes are an outstanding tool for bringing the level of dental treatment up to the efficient, reliable standards of modern medicine, rather than relying on the intuition and experience of old-fashioned dentists. As mentioned above, in order to make effective use of microscopes it is essential to use tools that do not obstruct the field of vision, to improve skills through training, and to be proficient with mirror techniques. In other words, we need to be very conscious that unless we have the diagnostic ability and treatment techniques to go with the equipment, microscopes may become white elephants. Also, as the time required to perform treatment increases, we need to consider ways to limit stress on operators and, it goes without saying, patients. Among some of the many other issues is the fact that the accuracy of treatment is not reflected in remuneration for medical treatment. We must remain conscious of the fact that simply using the latest equipment does not increase the accuracy of medical treatment.

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朝日大学におけるマイクロスコープの導入から現在の使用状況について

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近年，歯科用CTやマイクロスコープを使用した治療を求めるニーズが増えつつある．今回，本学においても行われてきたマイクロスコープの導入から現在の使用状況について報告する．

1998年，AAE（米国歯内療法学会）が米国歯内療法専門医の教育にマイクロスコープの使用を義務付け，本学では1999年から導入が始まった．歯内療法，歯周病のみならず保存修復，補綴領域での使用の可能性が高まり，現在，５台の顕微鏡が，診査や治療に使用されている．さらに，診断と治療以外でも様々な可能性があり，治療状況をモニターあるいは再生できるため，映像を使用したインフォームドコンセントを実施することで，患者さんへの簡単かつ説得力のある説明ツールとして有用性は高い．また，歯学部や衛生士専門学校の臨床実習生への臨床教育，コデンタルスタッフとの情報の共有などの応用が可能である．

マイクロスコープによる治療は，今まで見えなかったものを明るい視野で確かなものにし，歯科治療を効率的確実な近代医療にまで高めることが可能な優れたツールであることは間違いない．しかし，これを活用するには，新たな器具の使用，スキルアップのための訓練，ミラーテクニックに熟練することが必要で，すなわち，それを使用するわれわれ歯科医の診断能力や治療技術が伴っていなければこれらの機器も無用の長物となることを十分に認識すべきである．

キーワード：顕微鏡，先進医療，歯内療法，インフォームドコンセント，臨床教育

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