TELEDERMATOLOGY IN MORECAMBE BAY

P Harrison, Consultant Dermatologist
Morecambe Bay Hospitals

INTRODUCTION

The application of telemedicine to dermatology (teledermatology) is a new way of approaching patient management and a means of bringing dermatological expertise more effectively to patients. In Morecambe Bay, there is a mixed rural/urban population which is spread over a large geographical area. There are three main towns – Lancaster, Kendal and Barrow – and, like many areas, a relative under-provision of dermatological expertise for patient management. Furthermore, with pressures to reduce waiting lists and improve the access of patients for skin cancer management, telemedicine may be a method for improving dermatological management in Morecambe Bay. Although telemedicine can utilise either real-time techniques (eg video conferencing) or store-and-forward techniques (eg still photographic images), the approach used in Morecambe Bay has been still photographic imaging, both conventional and digital, with the aim of data transmission. Over a five-year period teledermatology in Morecambe Bay was studied in 1402 patients.

PHOTOGRAPHS FOR DERMATOLOGICAL IMAGING

Accurate photographic illustrations in dermatology have only been possible relatively recently. Prior to photographic illustration dermatology largely depended on written descriptions, but later artistic interpretations were possible with paintings and drawings. Early dermatological texts had no illustrations and it was only at the end of the eighteenth and early nineteenth centuries that dermatology texts used illustrations to explain dermatological problems more fully. There was an explosion in dermatological knowledge at this time, together with the classification of cutaneous diseases. An early text by Robert Willan had excellent drawings, probably only surpassed by botanical illustrations of the time. A comparison between dermatological and botanical illustrations suggests the superior quality of pictures of plants (Figures 1 and 2).

The later introduction of moulages involving wax models of skin problems improved the reality in images, but it was the introduction of photography, first black and white and then colour, which led to truly realistic reproductions of dermatological diseases.

Although photography has been used in medicine since the middle of the nineteenth century, more modern photographic processes have allowed pictures of high resolution to give accurate visual reproduction of dermatological problems. Now, digital technology allows photographic images of a quality comparable to that of conventional photography. The

Figure 1 Botanical illustration from text by Woodville (1793)

digital medium more easily facilitates data transmission, which will allow true telemedicine with image interpretation at a distance.

With developments in communication faster data transmission has been possible, which is suitable for telemedicine. Although a broad definition of telemedicine is the practice of medicine at a distance, a more modern definition includes computers and communication equipment.

Telemedicine is not a new concept. An early example was perhaps by the German Renaissance artist, Durer (1471-1528), who sent a painting of himself when asking advice on abdominal pain. Now, telemedicine can involve real-time or store-and-forward systems and can be used by a number of specialities including dermatology, radiology, cardiology, intensive care, A&E, psychiatry, pathology, oncology, neurosurgery and ophthalmology.

Figure 2 Dermatological illustration from text by Willan (1798)

In Morecambe Bay, questionnaires were used to examine patient satisfaction and general practitioner acceptance of telemedicine techniques. There was a preliminary assessment of the cost-effectiveness of still image teledermatology.

Conventional teledermatology

The first study involved a dermatologist assessing skin lesions from photographic images obtained by a medical photographer using a Nikon FM2 camera. Photographic prints were used to assess diagnostic accuracy and analysed on 38 conventional photographs from 26 patients. The photographic diagnosis was compared with the histological assessment of skin lesions (after tumour removal). Diagnostic accuracy was found to be 82% (95% confidence interval, 66%-92%).

Subsequent studies sought the views of 100 patients as to whether skin assessment by photography would be acceptable, using a visual analogue scale. Ninety-four percent of those who completed the questionnaire were satisfied that skin assessment by photography would be a satisfactory alternative to face-to-face assessment in a clinic.

One hundred and forty-one patients were then assessed, using the same low-tech approach with conventional photography, to determine whether the method could be used for remote patient management. A medical photographer took conventional photographs of skin tumours and the prints were later examined by a dermatologist. In this study the diagnostic accuracy was found to be 62%, lower than in the earlier study.

In each of these studies the gold standard was histological diagnosis and a larger conventional study was undertaken in which 656 patients attended for photographic assessment of skin tumours. Diagnosis from image assessment was again compared with diagnosis after histological removal of skin tumours, and in this study the ability of photography to predict if skin tumours were benign or malignant and determine tumour management was examined also. This is a better test of the method's ability to facilitate patient care. Data analysis indicated the diagnostic accuracy in this study to be up to 75% (95% confidence interval, 68%-81%), with the ability to differentiate between benign and malignant skin lesions in 94% of patients (95% confidence interval, 90%-97%). Furthermore, in this last study there was a high patient satisfaction, with up to 85% of patients being satisfied with the photographic service, and most general practitioners also confident of the ability of photographic imaging to help in patient management.

Although using conventional photography, these studies were able to demonstrate the ability of these techniques to facilitate patient management. Whilst not true telemedicine, if by that we mean data transmission, the studies showed that remote patient management could be achieved using a simple, low-tech approach. The next stage was to undertake digital studies in order to examine teledermatology using image transmission. Many digital cameras now have the same high resolution as the conventional single lens reflex (SLR) camera.

Digital teledermatology

Initially two small studies were undertaken, in order to establish whether digital methods could achieve the same standard as conventional photography for patient management. The first digital study used a Kodak DC40 digital camera, and mobile telemedicine was achieved using a laptop computer. The diagnostic accuracy was higher for tumours than for rashes, with 95% agreement between face-to-face diagnosis and image-led diagnosis for tumours, and 89% agreement for rashes. The next study, which used the internet for image transmission, resulted in 94% diagnostic accuracy for skin problems, primarily skin tumours.

The studies so far had involved Morecambe Bay, but the next study, an ISDN-based method, involved two hospital sites in Lancaster and Manchester and 136 patients were recruited over a six-month period. The same Kodak DC40 digital camera was used and the diagnostic accuracy of image assessment was compared with that of face-to-face consultations. The diagnostic concordance was 84%. There was good correlation between both methods of assessment and also between teledermatology and histological findings, with digital image analysis being found capable of distinguishing between benign and malignant skin tumours with 93% accuracy, 87% sensitivity and 77% specificity. Furthermore, in 96% of patients, treatment recommended after teledermatology was found to be adequate, with no patient receiving potentially detrimental assessment. Image quality was found to affect diagnosis, but image resolution did not, since the camera had a resolution of less than one million pixels (756 x 504 pixels). Higher resolution, more expensive cameras would not necessarily give significantly better results for diagnostic accuracy or treatment prediction, and experienced image interpretation was essential for achieving good management.

The digital studies established that digital technology could be used to achieve the same high quality images suitable for telemedicine assessment which could be used

for patient management. Simple off-the-shelf technology could be used for store-and-forward systems and achieve true telemedicine.

Figures 3 and 4 demonstrate that conventional and digital cameras yield photographs of similar quality.

PATIENT-LED TELEDERMATOLOGY SERVICES IN MORECAMBE BAY

Both conventional and digital studies had, so far, shown that photographic imaging could be used for patient diagnosis, particularly of skin tumours, and also help with patient management. A pilot service was established in Morecambe Bay with conventional and, later, digital technology for the management of patients with dermatological problems. The store-and-forward mode involving still photographs was used. A medical photographer took images of 181 patients over a six-month period. Diagnostic accuracy was 66% (comparing image assessment with histological analysis), with 96% of patients indicating that the method was acceptable and only 28% of patients indicating a preference to attend a hospital clinic.

Younger patients tended to express more concerns over the accuracy of telemedicine, and raised confidentiality

“ Younger patients tended to express more concerns over the accuracy of telemedicine, and raised confidentiality issues, whereas older patients tended to accept it. ”

to expedite hospital appointments, but this group also had more concerns about potential technological problems with telemedicine.

issues, whereas older patients tended to accept it. All patients were usually aware of telemedicine’s ability to speed up access to medical advice. There were differences in questionnaire responses, with professional and managerial patients indicating more awareness of telemedicine’s potential

Figure 3 Conventional photograph of squamous cell carcinoma affecting the ear

Cost analysis showed that telemedicine could sometimes be quicker than conventional clinics for patient assessment, and therefore useful for patient triaging, and also that still-image based telemedicine could be up to seven times cheaper than attending conventional hospital clinics (excluding medical time).

In the nine studies, and a pilot clinic service, involving 1402 patients in Morecambe Bay, telemedicine has been examined to establish whether it could be a suitable medium for patient management. Both conventional (low tech) and digital (high tech) approaches were assessed and the conclusion reached was that skin tumours can be effectively managed using telemedicine techniques.

A COMPREHENSIVE TELEDERMATOLOGY SERVICE

Telemedicine should not replace conventional medicine. It is likely that teledermatology will develop in parallel with conventional dermatology. Teledermatology should be seen as a method of improving dermatological practice, but not as a replacement for existing services. We shall still need dermatologists, indeed we shall need more of them, to examine and assess images.

Telemedicine cannot easily be used for counselling or giving bad news, and may not reassure all patients, but it can bring medicine nearer to the patient and help to improve waiting list management. Some dermatologists will embrace telemedicine and others may resist its benefits and technological attractions. But it is here to stay and we can effectively build the provision of dermatology services to include telemedicine techniques. Questions to consider are: who takes the images, and should they be acquired centrally, in a hospital, or peripherally in general practices? The advantages of central image acquisition are consistency of image quality and control over data flow. Many general practices or primary care resource areas may want their own telemedicine applications (incorporating Healthnet,

Figure 4 High resolution digital photograph of squamous cell carcinoma affecting the ear

Comparison between conventional and digital photographs of similar cutaneous lesions

NHS Direct and NHS Online), but whatever the method, teledermatology can be a useful adjunct to existing practice.

TELEDERMATOLOGY IN THE FUTURE

There needs to be more assessment of the cost benefits of telemedicine, and of patient satisfaction. Medico-legal issues will remain, since telemedicine methods may involve slightly more risk for both patient and practitioner. Nothing can replace the traditional one-to-one medical consultation in which both art and science are involved in the exchange of information.

In the future, artificial intelligence may feature more in telemedicine. An examination of a computer system involving neural networking computers (utilising fractal and chaos theory analysis) compared a panel of 12 general practitioners and eight nurses with the computer, assessing whether a skin lesion was benign or malignant. The computer system achieved 100% accuracy, compared with 78% accuracy by general practitioners and 81% by nurses. The best human accuracy in the conventional and digital teledermatology studies was 96%.

The future may bring increasing computer intelligence into medicine, enabling simple decisions to be made rapidly, thus facilitating patient triaging, as already illustrated in NHS Direct. Information technology and data transmission improvements will facilitate easier image transmission. A recent study in Morecambe Bay examined digital portable telephones and computer-led image transmission, with good quality images transmitted via mobile phones and the internet.

CONCLUSIONS

We live in a rapidly-progressing world, in which medicine is constantly developing. We must not, however, lose sight of the traditional aspect of medicine, and must acknowledge that telemedicine cannot replace the human aspects of medical practice. Properly implemented, supported and assessed, telemedicine offers enormous opportunities for the improved practice of medicine. In Morecambe Bay, teledermatology has been effectively used for dermatological management and could be a routine part of patient care.

Morecambe Bay Medical Journal Prize 2001

Mr Amit Kochhar, joint winner with Dr Huck Tan of the journal prize in 2001, receives an engraved platter from Peter Dyer, the editor of the journal.