The availability of microcomputers for use in occupational therapy is attributable in part to the same factors that account for the widespread adoption of microprocessor-based devices in businesses, schools, and homes. Factors such as decreased circuit board size and increased speed and memory have resulted in an extraordinary rise in the market demand for microcomputers (Walker, 1984). The large-scale production of computer hardware as well as improvements in manufacturing techniques have led to significant cost reductions. Moreover, the establishment of specialized software firms has allowed for the distribution of numerous comprehensible, ready-to-use application programs. Nonexpert users are no longer required to spend years and fortunes learning to use and enjoy their microcomputers.

These developments have prompted many occupational therapists to consider the use of this modality in their assessment and treatment approaches. Indeed, the number of occupational therapists (McGrath Spicer & McMillan, 1987; Sabourin, Weiss, & Ménard, 1988) and other rehabilitation specialists (Blakemore, McCray, & Coker, 1985) currently using microcomputers is striking, particularly when one considers that less than 5 years have passed since this technology became widely available and that most therapists have had minimal training in this field (Sabourin et al., 1988; Vanderheiden, 1987). Equally impressive is the range of therapeutic applications to which microcomputers have been applied, such as the assessment and treatment of cognitive and perceptual deficits (Kaiser, Korner-Bitensky, Mayo, Becker, & Coopersmith, 1988), adapted access (Everson & Goodwyn, 1987), fine and gross motor skill acquisition (Leclair, 1989), augmentative communication (Beukelman, Yorkston, & Dowden, 1985), prevocational assessment, and remedial education (Sidler, 1986).

Despite the growing interest in use of microcomputers as an occupational therapy assessment and treatment modality, however, there remain a number of factors, primarily related to their technical aspects (Reswick, 1983), that limit their widespread adoption in the clinical milieu. My purpose in writing this paper was to outline procedures for overcoming these limitations by (a) identifying the reasons why computers are not successfully integrated into the clinical facility; (b) proposing ways to correct these problems; (c) providing recommendations concerning the acquisition of the major microcomputer hardware, software, and adaptations; and (d) providing an annotated list of resources for those in need of further information.

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Underusage of Computers in the
Occupational Therapy Clinic

One of the major factors limiting the clinical use of devices such as microcomputers and their associated adaptations is inadequate user preparation. The field of microcomputer applications to occupational therapy is characterized by an abundance of jargon, a scarcity of simply and clearly written reference materials, and a majority of users who have received little or no specialized instruction. Occupational therapists who have not acquired this education during their undergraduate years and who have had little time to take continuing education courses or to read technical journals are faced with a formidable task.

This is a serious problem, because the probability of the effective use of devices based on recent technical advances is directly proportional to the extent of user preparedness (Burkhead, Sampson, & McMahon, 1986; Roessler, 1986). The provision of even minor amounts of instruction and supervised hands-on experience can significantly improve the operation of these devices, and substantial training can result in imaginative and innovative users (Vanderheiden, 1987). Moreover, adequate training does much to alleviate the negative attitude and computer phobia that result from inexperience and unfamiliarity. Most of the problems addressed in this paper are a direct result of inadequate preparation.

A second factor limiting the use of technologically advanced devices is the expense associated with their acquisition and maintenance. Although the cost of microcomputer components has been decreasing steadily, neither the initial capital outlay (i.e., the purchase of hardware and software) nor the ongoing operating expenses (e.g., floppy disks, service contracts) can be easily incorporated into the departmental budget, which typically has already been reduced by years of financial restraint. Moreover, the exceptionally rapid obsolescence of computer equipment as well as the high salaries of qualified technical personnel (Roessler, 1986) means that future capital and operating expenses will remain relatively high.

The third challenge therapists encounter is the selection of suitable hardware, software, and adaptations from an incredible number of possibilities. Lacking sufficient knowledge, experience, and time, users rarely judiciously select the optimal set of components for their particular application. Rather, the decision is made in one of two ways. In the first case, a device is chosen by default—It is one of a small subset of existing equipment known to the user. Thus, the popular Apple IIgs seems to be selected more often for its high profile than for its attributes. In the second case, the decision is forced by administrators who, because of other priorities, advocate a device with little regard for its suitability for the specific application. For example, the facility administration may argue that the purchase of a microcomputer compatible with those available in other departments will facilitate system maintenance and software acquisition. The novice may have difficulty debating the logic of compatibility. Microcomputers, however, are often function specific; the system that is ideal for database and word processing applications may be inadequate for assessment and treatment purposes. In both cases, the therapist does not have sufficient knowledge to justify a system different from the one being promoted by colleagues or superiors.

The fourth limiting factor occurs during the period immediately following the acquisition of a microcomputer, a time that is critical to the extent and quality of its future use. During this time, users are both enthusiastic and apprehensive, and the potential for mishaps is greatest. The various hardware components may be missing or incorrectly assembled. Suitable software may not yet be available. A quiet, private work area with appropriate furniture may not be arranged. Little thought is likely to have been given to issues of scheduling and security. Manuals and floppy disks may not yet be organized and indexed, nor instructions and guidelines prepared. New users are unaware of the necessity of fundamental tasks, such as making copies of disks before someone inadvertently erases all of the programs. All of these concerns arise from the fact that, except in the rare case of voluntary product support by the sales representative, there is no one to advise the therapist in the basic principles of system management (Bowe & Little, 1984).

A fifth difficulty arises from the rapid obsolescence of microcomputer equipment. Innovations in microcomputer devices and programs occur so frequently that therapists risk becoming out of date if they do not continue to explore new developments in the field. Resource materials are plentiful: Specialized computer magazines, journal articles, users' groups, electronic bulletin boards, and conferences abound. Information that is pertinent to a specific application and available in a format and at a level appropriate to the user, however, is not so readily obtained. For example, on-line help services on an electronic bulletin board will not assist the user who does not know what a modem is or how it functions. Moreover, many therapists cannot take time away from direct patient care to follow the microcomputer literature.

Finally, the user's outlook is an important factor. Timid, anxious, or skeptical attitudes can bias users' estimates of their abilities as well as alter their perception of progress made, often resulting in the implementation of a microcomputer system that is either too ambitious or too modest in scope.
Strategies for Minimizing Computer Difficulties

Microcomputers will be most successfully integrated into the department if goals are clearly defined and strategies for implementation are established well before acquisition of the equipment. It is important to note that many of these implementation difficulties are not unique to microcomputer applications in the clinical setting. For example, more traditional interventions, such as orthotics, various test batteries, and the neurophysically based treatment modalities, make use of highly specialized terminology, use substantial portions of the budget, and require time and money for continued education. Periodic comparisons to other departmental activities will help both clinicians and administrators keep microcomputer requirements in perspective.

Convince Yourself That You Need and Want to Use Microcomputers

The difficulties outlined above arise primarily from a combination of issues related to time, money, and attitude. These issues can be resolved, but not unless both therapists and administrators are convinced that microcomputer applications can contribute to occupational therapy. Otherwise, they will balk at allocating the time and financial resources needed to acquire sufficient equipment and supplies and to train staff appropriately. Because the appearance of new devices and techniques can trigger short-lived but expensive fads and because reported results are often anecdotal, a certain degree of skepticism is warranted.

This skeptical attitude stems from the absence of extensive literature demonstrating the validity and efficacy of computers. Many articles describe various assessment and treatment applications (e.g., Lau, 1986; Vanderheiden, 1987), but only recently have these interventions been manipulated experimentally (e.g., Chubon & Hester, 1988; Everson & Goodwyn, 1987; Kirschenbaum, Friedman, & Melnik, 1986) to investigate the validity of a particular approach or to compare outcomes to those obtained with traditional modalities. Although their findings indicate that microcomputer adaptations can augment a client's abilities, the field is still in a developmental stage and such results should be viewed cautiously. Nevertheless, the many, readily apparent advantages of the microcomputer should not be overlooked. Its suitability for standardizing assessment presentation (Wilson & McMillan, 1986); increasing the availability of high technology adaptations (Vanderheiden, 1987); providing self-directed, instruction-based activities; and improving the employment potential of persons with physical disabilities (Szeto, Allen, & Rumelhart, 1987) may be used to convince the skeptic.

Other useful information sources are available in publications produced by companies and organizations interested in the applications of microcomputers to rehabilitation. Most of the articles within these publications, which are listed below, are suitable for the microcomputer novice. Note that this list represents only a sample of the most useful computer hardware, software, and adaptations. (See the Appendix for information on where to obtain these publications.)

- **Access Details** is a four-page newsletter describing AbleNet's products and programs. It is free and contains many simple suggestions for the use of automated learning devices for persons with physical disabilities.
- **American Journal of Occupational Therapy** publishes a column containing reviews of microcomputer software.
- **Canadian Journal of Occupational Therapy** publishes a column entitled Technology Update in which microcomputer applications to rehabilitation are reviewed.
- **Closing the Gap Newspaper** is a 30- to 40-page bimonthly newspaper containing articles and advertisements on various microcomputer applications for rehabilitation and special education. Information includes product previews and a list of future conferences and events. The yearly subscription rate is $26. One issue each year includes the Resource Directory, an updated annotated listing of all relevant computer hardware and software.
- **Directory of Canadian Occupational Therapy Microcomputer Users**, published by the Canadian Occupational Therapy Foundation, lists each user's facility address, telephone number, and contact person, type of microcomputer, adaptations, and therapeutic applications. The current edition (March 1990) is available for $8.
- **Journal of Cognitive Rehabilitation** includes articles relevant to microcomputer applications for cognitive evaluation and treatment. Of particular interest are the "Soft Tools" listings of sample programs for most of the popular personal computers. The programs published in each issue of the journal can be obtained on disk for approximately $36.
- **Neil Squire Foundation Newsletter** is a free 12-page newsletter containing articles of interest to persons dealing with technical aids for disabled persons. It highlights the various activities of the Neil Squire Foundation, including...
available courses, products, and volunteer programs. The Foundation also publishes RRADNET, a rehabilitation research and development network bulletin.

- **PRC Current Expressions** is a free six-page newsletter that focuses on augmentative communication. Articles submitted by users with disabilities enhance this publication.

- **Radio Shack Special Needs Catalog** is a 40-page catalog containing various electronic technical devices. Radio Shack has recently arranged to carry TASH and DADA (i.e., the PC AID) products.

- **TASH, Inc., Catalog** contains 36 pages of the major adaptations for the Apple II, IBM, and Macintosh microcomputers.

- **Trace Center Reprint Service** produces a catalog listing their numerous publications. Materials include reprints dealing with policy and planning, technical instructions for constructing and using adaptations, and comprehensive resource guides of microcomputer information. The prices for these materials are listed in the catalog.

- **Window on Technology** is a free 16-page review of products and programs that use technology to improve the lifestyles of persons with disabilities. This bimonthly publication is also available through a modem.

**Engage the Services of an Expert**

Once short- and long-term goals specific to the application of microcomputers in the department have been clearly defined, it is important to engage the services of an expert. Although some pertinent information may be obtained through informal phone calls and ad hoc consultations with colleagues, it is unlikely that advice obtained in this way will be systematic and thorough. Thus, one should hire a paid consultant who can advise on hardware, software, and adaptations appropriate to the designated clinical applications and simplify tasks for the novice user. Such advice must be obtained before any major decisions are made and, preferably, before discussions begin with the facility administration. An expert who has had considerable experience in microcomputer applications to occupational therapy will be most able to help design a relevant system as well as provide information at a level appropriate to the therapists. Be aware, however, that because of this field’s newness, it is best not to rely on the advice of just one person; recommendations based on one-time experiences with a particular system may be completely unsuitable to other applications.

**Explore Alternative Financial Sources**

Besides monies available through standard budget requests, other funding sources should be explored. For example, hospital auxiliary groups and service organizations will often consider funding the purchase of a major new item. Temporary solutions used to demonstrate the potential of microcomputers to those controlling the budget should also be explored. Thus, the department could arrange to share a system that has been made available for use by a particular client or arrange for a short-term rental. Although rentals from privately owned companies will probably be too expensive for most operating budgets, better rates may be available from schools or universities during the summer when their equipment is not in use. Finally, because not all system components need to be purchased initially, a system adequate for one of the designated purposes may suffice for the first year, with additional components added as funds become available. For example, during the initial stages, an effective microcomputer therapy program could function adequately without a printer or a hard disk.

**Appoint a Microcomputer Management Group**

One person or a designated group of therapists should assume responsibility for departmental microcomputer applications. Preferably, given the number of skills required and tasks involved, at least two people should share these responsibilities. A wealth of computer knowledge or experience is not required; of greater importance are attitude and aptitude. If a group is to be chosen, its members should be technically oriented, interested in the field, aware of the software's applications to occupational therapy, able to guide and teach others, and willing to accept the additional responsibility.

The microcomputer management group's primary function will be to act as organizers and resource personnel. Under the guidance of the appointed consultant, the group should first acquire and catalog pertinent information on computer hardware, software, and adaptations. A collection of several of the publications listed above will serve as an initial source of information. To perform their functions thoroughly and systematically, the members of this group will require some time away from their other clinical duties, particularly during the first few months after the acquisition of the microcomputer system.

**Allocate Funds**

The next step involves identifying the system components appropriate to the application and determining the amount of available funds. It is at this stage that...
major decisions have to be made. For example, is it better to acquire a system compatible with others in the facility and suitable for departmental purposes but different from those being used elsewhere in occupational therapy? Is it worthwhile to purchase a moderately outdated system that costs less than half the price of the latest model?

Know the Hardware and Software

The microcomputer management group must become aware of the major hardware and software components relevant to their particular applications. It is beyond the scope of this article to give an exhaustive review of all possible components, but some of the major items as well as recommendations concerning their acquisition are provided below. Further details may be found elsewhere (e.g., Downing & Covington, 1986; Selkirk, 1986; Walker, 1984).

Central processing unit (CPU). This is the part of the computer that performs arithmetical and logical operations and controls instruction processing. Each kind of microcomputer (e.g., Apple IIgs, IBM compatible) has a unique CPU configuration that must be compatible with the programs and adaptations required for clinical application. Thus, before making any decisions, the clinician should identify which programs will be used and whether the microcomputer in question can be adapted as required. For example, the Apple II computer is often chosen for its many game and assessment programs as well as for its adaptability to altered access.

Primary memory. This is the space within the computer where information is stored. Memory size is usually identified in terms of the number of kilobytes it contains; each kilobyte represents 1,024 units of information. There are two types of primary memory. Read-only memory (ROM) contains specific instructions and working data that are built into the microprocessor chips. Random-access memory (RAM) stores programs and data while the user works on a specific task. This short-term working memory is erased when the computer is turned off. Most of the new microcomputers come with at least 256 kilobytes (e.g., Apple IIgs), 640 kilobytes (e.g., IBM), or 1 megabyte (e.g., Macintosh SE) of RAM and can often be upgraded with additional RAM. It is important to find out whether all of the programs to be used can be easily run with the standard RAM or whether memory upgrades will be required, because extra memory can be expensive. Graphics, music, and some of the newer word processing programs in particular require a lot of RAM.

Secondary memory. Also referred to as external memory, secondary memory is of two main types: floppy disk or hard disk. Information is stored on these disks by a process that involves magnetizing their iron oxide surfaces. A floppy disk is a thin, square piece of plastic that comes in two sizes—$5\frac{1}{4}$ in. and $3\frac{1}{2}$ in. The $5\frac{1}{4}$ in. floppy disk is more fragile and contains less storage space than the newer $3\frac{1}{2}$ in. type. A disk drive capable of retrieving information stored on these disks is required. When a floppy disk is first purchased, it can be used with any microcomputer as long as it fits into the disk drive. Once the floppy disk has been formatted (i.e., magnetically organized into storage sections) for a particular CPU, however, it can be used only with that type of microcomputer.

Users have the choice of purchasing either $5\frac{1}{4}$ or $3\frac{1}{2}$ in. disk drives. The $3\frac{1}{2}$ in. disk has only recently become more widely available, and users who wish to make use of both older programs (which tend to be available only in the $5\frac{1}{4}$ in. format) and newer programs (which are more readily available in the $3\frac{1}{2}$ in. format) are recommended to purchase a disk drive of each size. The hard disk, sometimes referred to as a fixed disk, is usually permanently mounted in the computer and cannot be removed. A hard disk is strongly recommended for facilities that will be storing large amounts of data or where patients with severe physical disabilities will be expected to manipulate their own programs.

Back-up copies of programs are much easier to make if the microcomputer system has at least two secondary storage units. Different combinations will work (e.g., two $5\frac{1}{4}$ in. floppy disk drives or one hard disk and one $3\frac{1}{2}$ in. floppy disk drive). This is one example of where a partial system can be purchased initially (e.g., one floppy disk drive) and upgraded at a later date.

Monitors. Monitors are used to display computer characters. Monochrome monitors display only one color (usually white, green, or amber). The sharpness of the image on the screen (the resolution) is specified in terms of bandwidth (rated in megahertz). A good quality monitor should have a bandwidth in the range of 18 to 20 MHz. Patients with visual impairments may have difficulty viewing material on monitors of lower quality. Monochrome monitors should be purchased by those facilities that will be concentrating on database and word processing applications, because in these instances higher resolution is most important. Most games and assessment programs require a color monitor.

Keyboards. Keyboards vary in size (i.e., the number of keys), shape, and whether they can be detached from the main part of the computer. A detachable keyboard that is extended (i.e., that has separate areas for function keys and a numeric keypad), which allows easier access, is preferable. This is standard for
most IBM compatibles and can be obtained for Apple computers for a small charge.

Alternate input devices. A mouse, trackball, a joystick, and game paddles are all standard input devices that give the person with a physical disability an alternate method for controlling some computer programs. The joystick and trackball are particularly useful for persons who have difficulty accessing a standard keyboard. These items must be purchased separately for most microcomputer systems. The user should ensure that the software of interest supports these alternative input devices.

Adapted access interfaces. These include several devices that enable the person with a physical disability to access the computer by means of switches and specialized keyboards. The selection of an adapted access interface depends on the type of microcomputer. Therapists working with patients with moderate to severe physical disabilities should seriously consider acquiring an adaptive access interface as well as several switches and at least one of the adapted keyboards.

The adaptive firmware card, designed to fit into one of the empty slots inside the Apple II, enables computer characters to be entered by means of scanning, Morse code, and specialized keyboards. It also enables the therapist to slow the rate of program execution. This latter function permits the use of many general purpose game programs that would otherwise be too rapid or complicated for therapeutic applications. Different versions of the adaptive firmware card are required for the different members of the Apple II family; the Apple IIgs version is the easiest and most flexible to use.

The PC AID and PC Serial AID are devices that allow adapted switches and keyboards to be used with PC compatibles. They also enable the use of scanning, Morse code, adapted keyboards, and the assisted keyboard, but they do not have a slowdown feature. The PC AID is sufficient if only switches are required. The PC Serial AID, however, allows for the use of both switches and keyboards. Both the PC AID and the PC Serial AID are less expensive and easier to use than the adaptive firmware card because they use the IBM's RAM.

The headmaster device enables the user to control Macintosh computer mouse movements with head rotation. A mouth or thumb switch is used to select items. This device is more expensive and less flexible than either the adaptive firmware card or the PC Serial AID but does permit the Macintosh to be adapted.

Printers. Printers come in many varieties, including dot matrix, daisy wheel, and laser printers. They differ in terms of print quality and cost. Users are advised to view sample text and graphic documents before purchase to ascertain whether the quality is sufficient for their needs. Some printers require cables that transmit data from the computer in parallel (i.e., eight data bits are transmitted simultaneously over adjacent wires within the cable). Other printers require cables that transmit data in a serial format (i.e., data are transmitted one bit at a time over a single wire). Laser printers produce high-quality hard copies but are quite costly. Daisy wheel printers cannot be used for graphics. Many of the newer dot matrix printers are reasonably priced and are capable of producing letter-quality print. Not all printers work with all microcomputer models. For example, the Apple II requires a printer that can support a serial rather than a parallel interface. Some microcomputers require special printed circuit cards that must be purchased separately. Printer cables are not always supplied with the microcomputer system; the user must specify whether the required connectors are serial or parallel, male or female.

Software. Numerous application programs are now available for all the major microcomputer systems. Only the most basic software (e.g., programs that format and make backup copies of disks) is provided by the manufacturer when the computer is purchased. Often, little or no money is allocated for software, and many users rely on copies of programs. In addition to the ethical and moral issues involved with the use of copied software, there is the concern that programs may not be used correctly due to insufficient documentation. Moreover, computer viruses, which are caught from illegal disk copies, represent a real threat to programs and data currently on the computer. Another problem is related to the size of the software collection; often it is so small that the microcomputer is not used to its fullest potential. The initial collection should include several assessment and game programs as well as some basic administrative software (e.g., word processing). Therefore, at least 10% and preferably 20% of the computer budget should be designated for the acquisition of programs.

Computer Purchase

The microcomputer management group will probably be involved in preparing a budget proposal. Several computer dealers should be called, because prices vary considerably. Some dealers may also offer educational discounts on equipment. Estimates for all capital and operating expenses should be included in the budget. A common mistake made in fund requests for microcomputer equipment is the omission of additional expenses that are essential for smooth system operation (e.g., adaptive devices, service contracts, supplies).
Office Preparation and Computer Installation

Before the microcomputer system arrives, the microcomputer management group should set up a quiet, private work area suited for the anticipated tasks. The acquisition of specialized computer furniture and materials, including adjustable tables and support surfaces for adaptations, will increase the computer's accessibility and foster its use. Numerous models of tables, chairs, keyboard trays, copy stands, printer stands, and monitor supports designed in accordance with ergonomic principles are now available. An adjustable table and monitor stand are essential. The table should have work surfaces that can be manipulated vertically and horizontally (preferably with separate controls for monitor and keyboard surfaces). The monitor stand should allow the screen to be tilted to minimize glare. Sufficient work space should be available for items such as disks, mouse pads, and notes.

Given the cost of this equipment and its delicacy, security and safety procedures should be established. Most distributors offer an extended warranty service for a reasonable fee, depending on the complexity of the microcomputer system. This is a worthwhile option for departments within facilities that have little or no technical support. A service contract in which the equipment is returned to the store for repair is much cheaper than one that involves on-site service.

Once the computer system is acquired, the management group must verify that all components have been delivered and are working correctly. In most cases, the distributor will, at a reasonable cost, install the microcomputer components. (Note that the installation of adaptations will have to be done by members of the computer management group.) Warranties should be checked for expiration dates and arrangements made to obtain service contracts on the more expensive items.

To foster good computer work habits and minimize the loss of valuable data, the management group should establish a system management protocol. These tasks can include making backup copies of all disks, organizing a schedule of computer use, and drafting a list of standing rules (e.g., no eating or drinking near the computer). Instructions and guidelines outlining all important and recurring procedures should be prepared and distributed to all users. Directions for general purpose computer applications (e.g., formatting disks, using word processing software, printing files) and for specific rehabilitation applications (e.g., programming the adaptive firmware card for use with a particular input method and rate), therefore, should be readily available. Program and data disks can be inadvertently destroyed and equipment can be stolen. Copies of all disks should be made and stored in a secure location. Special locks can be purchased for securing the microcomputer to furniture; otherwise, the system should be placed in a room with a lock.

None of the tasks outlined above need to be performed by occupational therapists, although at least one therapist should be involved in order to keep the operation therapeutically relevant. A number of the necessary functions, including disk inventories and supply orders, can be delegated to the departmental secretary, aide, summer student, or volunteer with some computer background. These persons, however, must be under some central authority.

Arrange for Instruction

The expert consultant, in conjunction with the members of the computer management group, should provide a series of well-defined seminars for other departmental users. The objective of these seminars is to orient novice users to the most relevant microcomputer applications, with an emphasis on demonstrations of how specific programs and adaptations function. Less emphasis should be placed on computer literacy, although one or two introductory sessions on topics such as disk formatting and printer usage are worthwhile. If time permits, the information contained in these instructional sessions could be compiled as teaching modules for reference purposes.

Continue to Communicate With Others

You can continue to learn about microcomputer applications in various ways, such as through computer interest groups, courses, workshops and computer shows, journal articles and newsletters, and electronic bulletin boards. As the expertise of the group increases, new applications will be discovered and this will, in turn, facilitate the acquisition of additional equipment and programs.

Conclusion

The microcomputer is clearly becoming a useful adjunct to traditional occupational therapy treatment modalities. Clinicians, however, have received insufficient training to cope with microprocessor-based devices that are technically complex, continually evolving, and costly. By identifying the major sources of difficulty and by presenting clinically feasible solutions, I hope that I have provided information that will help to alleviate the major obstacles to the successful integration of microcomputers in the occupational therapy department. Clinicians who follow the step-by-step procedures outlined in this paper and who obtain sufficient guidance from experts who are knowledgeable in both therapy and microcomputer applications to rehabilitation are well on their way to becoming proficient users of this versatile treatment modality. ▲
References


