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How Technology Usage is Altering the Field of Occupational Therapy.

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Senior Thesis

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Abstract

Technology has made an impact is every aspect of life including in the field of occupational therapy. The technological advances has allowed for more specific diagnostic techniques that have lead to more specific therapy. The specificity of the therapy has allowed for more improvements in the ability to perform all activities required for daily living. Therefore allowing for more independence or increased independence for people who without this technology would be dependent on others for certain life tasks. The idea of increasing technology to make life easier allows for those in need of occupational therapy to have the ability to life a fuller more independent life without necessarily regaining full ability. The technological increases that make life easier are improved splinting techniques, improved prosthetics, more research into various adaptation aids and more distinctly developed therapies based on improved knowledge.

How Technology Usage is Altering the Field of Occupational Therapy.

Occupational therapy is a fairly recent addition to the medical field, in terms of the current goals of the field. The goal of occupational therapy is to help people live the highest quality of life possible. The highest quality of life varies between people and it fully depends on the abilities that they personally have. The official definition of occupational therapy is to promote, improve, or maintain the ability of people to engage in basic and instrumental activities of daily living: work, education, leisure, play, social participation and sleep occupations that are meaningful and necessary (American Occupational Therapy Association, 2010). Technology has allowed quality of life to be enhanced for multitudes of people. The further technology has increased the more realistic and helpful it has become to people for a variety of reasons. Technology has increased the effectiveness of splints, the realism of prosthetics, the greater ability for recovery for various traumatic injuries and diseases, and the more ability of intensive diagnoses leads to a more specified treatment.

Technology has increased at astronomical speeds leading to constant changing and rapid upgrade, which allows for a more specialized and physically specialized products in regards to daily living. The more prevalent and specialized technology has become the more it is becoming integrated into daily living, especially for those who need assistance. The technology boom has altered just about every field and ideal for the field of occupational therapy. From diagnostic tools detailing the deficits the person experiences to how they live in everyday life to the ease of living created through various technological feats.

The increase in the use of daily technology has allowed for increased adaptations for a person with disabilities that was previous never even a consideration in years past.

Technology has increased the realism of prosthetics in ways that mimic natural limbs, increased the ease of getting around for people with disabilities, created specialized tools for various ailments which allow for a "normal" life, and it has allowed increased healing for accidents and illness. The more that is learned about the human body, its physiology and its development the more technological improvements that can ease the burden of everyday tasks.

The technological improvements made in the field of occupational therapy since its inception has caused the rapid expansion of the field and the increased use of therapy. The philosophy of helping people live a more "normal" life through various exercises and modification to daily instruments has allowed for an increased idea of what is normal and what people with disabilities are actually capable of. With various therapy techniques and technology on the side of the occupational therapist, the better the outcome for the patients.

Defining Therapy

The definition of normal in terms of daily living and occupational therapy is the ability to do the tasks required in ones everyday life to the best of their abilities with the proper amount of modification and assistance with those tasks as necessary. Some normal tasks done by most everyone is feeding, bathing, using the restroom, daily grooming and dressing, handling money, reading, writing, to fine motor skills such as writing and picking up small objects and to gross motor skills such as walking, sitting, which are known as activities of daily living. The abilities of people vary with age, disability, illness, accident and a variety of other reasons. Every person might have a varying ability of what they can

do but everyone at some point in their life learned how to do every activity they can do. As an infant only certain reflexes were developed such as sucking and grasping, which required for continuous care for every other aspect of life but through out life it was learned to do every task that has the possibility of being done as a grown person. For an infant the idea of controlling a movement, such as moving an arm is an incredibly hard task that must be learned after a period of weeks but most adults don't even have to think about moving any given body part. This is the same with someone going through therapy, they are relearning (if they are an adult) or learning for the first time (if they are a child) basic skills needed for life. The intensity of the skills that are being learned or relearned varies from patient to patient. With that being said it is important to note that each patient is an individual with different abilities so every therapy session is different from the last even if the initial diagnosis of the patient is the same.

Diagnostic Measures

Diagnostic measures have increased tremendously over the past few years. There only use to be the ability to take x-rays but not the field has expanded in such a way that it is possible to use imaging techniques that show the parts of the brain being used during certain tasks and therefore what portion of the brain has been damaged. The more specific the diagnostic techniques have become the more specific the treatment can become and more specialized for the individual so that the patient can get the most of the therapy. The increase in diagnostic ability has also allowed for more specific physiological understanding of what portions of the brain control what parts of the body and what will

result from the specific damage created. The more the body is understood the greater the ability will be to heal the injured parts of the body.

Developmental Knowledge

One interesting concept learned about the human body is that it develops in a very specific way in terms of movement and brain development. The development of muscle control starts at a very young age and is commonly noted through normal childhood milestones. Muscle control develops in a way that main gross motor skills develop in the trunk then the gross motor skills of the limbs develop and lastly the fine motor skills of the hands and feet develop. The specificity of the muscle development makes physiological sense due to the fact that large muscle groups that are used for basic motions develop before the finite muscles for specific motions because the body needs to learn how to control the muscles and the brain needs to make connections regarding the movements that have taken place. Each significant development in terms of muscle movement builds off the previously developed and controlled muscle system. The initial movements capable of being done by a neonate include mainly reflexes, which are involuntary movements that are required for life, such as sucking and grasping. Once the muscles have developed the tone and strength needed to complete movement done outside the womb the infant will acquire the ability to support their head. This requires the use of neck and back muscles that will eventually be used for posture and will continue to support the head through out life. The supporting of the head then allows for more trunk muscle development that allow for controlled head movement and strengthening of the rest of the main gross motor

muscles of the trunk. Once the trunk muscles are developed the limbs gain the ability to start to develop controlled voluntary movement rather then just flailing, uncontrolled and unintentional movements. The uncontrolled movements done by infants allows for muscles to be strengthened in the limbs. Once voluntary limb movement occurs this signifies that muscular control is occurring and that the next step of fine motor skills can be initiated in terms of development, which are the fine motor skills. Fine motor skills include all movements done by the furthest distal limbs, mainly the hands. Fine motor skills will develop through out life and begin development in infancy. This is the stage of infancy that starts when the infant acquires the ability to pick up objects that get increasingly smaller in size. The smaller the object is the more control that has been developed. This is the stage when the child will find everything on the floor no matter how tiny the object is. The fine motor skill development is increased when the ability to write and color begins.

The ability to use fine motor skills is crucial to daily living. It is used in writing, typing, dressing, and picking up objects and many other ways. The specificity of the fine motors skills, specifically opposition the ability to touch your thumb to pinky finger, is something that is unique to only humans. This concept of fine motor skills is something that needs to be properly developed in children so that the child will be able to master school activities, specifically writing easily. This why certain childhood toys focus on fine motor skills, such as button pressing, placing objects into specific slots, lacing, peg boards, play dough and have become common toys for millions of children. The more the child gets the chance to use their fine motors skills the quicker development will occur and the more rapidly the skill set will expand and increase in development.

Therapy Planning and Development

The planning of a therapy session for the patient requires a diagnosis for the reason behind the therapy and an initial evaluation of the patient. The evaluation of the patient is the most important part of the planning for the therapy because it allows the therapist to determine the abilities of the patient and what actually needs to be learned or relearned for the patient. In the initial evaluation of the patient the occupational therapist will get to know the patient and the abilities of the patient through a series of tasks performed by the patient specific for the reason for therapy. If the patient is able to communicate to the occupational therapist the patient will get the chance to describe what problems they are having. This is mainly used when the patient has previously had the ability to do certain tasks and an event in their life has altered their ability to do the task. The evaluation of the patient allows for a specific therapy plan to be determined for the specific need so of the patient.

Once the initial therapy plan has been developed the occupational therapy will begin for the patient. The type of therapy will vary along the lines of the age of the patient, the reason behind the therapy and the overall ability of the patient. If the patient is a young child the main occupation for that child is essentially playing and coordinating their body movements so the therapy will consist of playing activities that allow the child to increase their functional development to an appropriate level. If the patient is an older child or an adult the therapy will work on restoring any lost ability and increasing the ability to the previous level of ability if at all possible. This means that the goals of the occupational therapy will to increase the strength and abilities of the patient to the highest level possible with hopeful full recovery for all lost abilities.

How Technology Usage is Altering the Field of Occupational Therapy.

The want for full recovery (in terms of adults and older children) and proper developmental abilities (in terms of children) is the main goal of the occupational therapy performed on the patient. Depending on the reason behind the therapy a full recovery can be accepted even though certain manipulations need to be made for various aspects of life. The manipulations needed for daily life allow for an easier time doing certain tasks, which make life easier and the patient fully capable of normal life. This is where the changes in technology are allowed to assist in daily life.

The technological changes made to simplify life might not seem as impressive as the news making technological feats but for the patient the technology makes a world of difference for them. Formally an "assistive technology device is any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase maintain, or improve the functional capabilities of individuals with disabilities" (American Occupational Therapy Association, 2010). The technologically created objects in occupational therapy seem simple, such as thicker writing instruments, to interesting, such as specialized splints, to impressive, such as prosthetics. The formal definition of assistive technology devices allows for just about everything used by occupational therapists in an assistive way to be considered under the definition. That means that the intensity, creativity or commonality of the objects used in therapy for their ability to ease the stress of everyday living has nothing to do with the impressiveness or uniqueness of the object itself as long as the goal is accomplished.

Mild Adjustments

Sometimes the simplest adjustments to objects makes a formerly difficult task that much easier. If a patient has a difficult time with opposition and fine motor skills certain adjustments will need to be made to certain objects to increase the ease of life. An adjustment that increases the ease of living to find or create a thicker specially shaped writing instrument. Increasing the diameter of a writing instrument will decrease the amount of fine motor skills required to write which will allow the patient to be able to write without fully regaining or learning the fine motor skills until the ability has been developed. A specialized shape to the writing instrument will increase the ability to hold the writing utensil without having developed the full motor set required for standard writing utensils. The simplistic adjustment made to the everyday object has allowed for more independent activities for the patient. The seemingly simple adjustments to the everyday objects increases the ability of accomplishing tasks that would be near impossible for people without the adjustments made to the objects.

Object adjustment is used in for areas then just writing, it is also commonly used in all other aspects of life that required fine motor skills. One simple task that requires modification until full strength can be developed is the use of scissors. Scissors require the clenching and subsequent release of the hand and fingers to cut the paper, which can be difficult if movement and strength is compromised. This has resulted in the creation of scissors that are easier to squeeze and open without stretching then hand just relaxing. The use of these scissors allow for the initial cutting motion to be achieved without the force required for normal scissors. Once the motions required for using scissors have been learned normal scissors are sometimes modified until development is complete. Some

modifications include using smaller scissors, which require less hand movement for use or for adjusting the size of the handles. If the size of the handles is decreased it allows for less force to be applied for same amount of movement. This allows for increased motor coordination of the hands and a strength increase therefore increasing scissor using ability and an increase in fine motor coordination.

Fine Motor Skills

Fine motor skill usage is one area where technology is altering development not always is a good way. The best way for fine motor skill development is to allow infants to properly develop gross motor skills, which by default creates a gateway that allows for proper fine motor skill development. The gross motor skills of infants best develop when they are allowed to lie on the ground and have the ability to explore their world. Infant curiosity will cause them to want to move around and reach for objects allowing for proper muscular development. This development is hindered if the child doesn't have the ability to explore or the child is kept is car seats or other chairs for long periods of time that cause limited mobility. Limiting the gross motor development causes problems with fine motor skills. The problems with the fine motor skill development must be worked on in the way in which children develop so that means that gross motor skills must be worked on and fully acquired prior to the development of the fine motor skills.

A big technological change is the use of computers. In terms of childhood development the use of computers might "replace some early childhood activities that are essential experiences to children's physical, psychological and social development" (Li and Atkins, 2004). The essential experiences in childhood include playing with tangible toys,

playing outside, peer interaction, and physical activity. The childhood experiences allow for proper development of motor skills and social skills, which will be helpful for a lifetime. If proper development does not occur the child will have a harder time in schools so the overuse of computers for "learning activities" might be negated in all benefits if the child is having difficulty writing and completing the school work.

Splinting

One primary focus in occupational therapy is the use of splinting. "The clinical aims of splinting include reducing muscle spasticity, managing pain, improving range of motion (ROM), preventing and/or reducing contractures, assisting with hygiene, enhancing functional activities or independence in activities of daily living, preventing overstretching and edema." (Adrienne and Manigandan, 2011). The idea of splinting is to decrease the damage being done to the specific site and to allow the proper healing of the site. Most splints are custom made or adjusted to each individual person this allows the greatest effectiveness of the splint itself. The effectiveness of each splint varies between injury, disability and overall adjustments needing to be made. The increased specificity of the splints due to increased knowledge and diagnostic techniques has allowed for increased healing and normalcy following the splint. To increase the effectiveness of the splints diagnostic measures are used to determine current mobility of the joint and the deficits that have become apparent. Most diagnostic measures include having the patient perform various tasks to determine ability and an evaluation of the joints and muscles in question for proper formation, development and performance. Once all measures are made the use of a specific splint is determined and therefore developed specifically for the patient. Once

developed the splint will be worn by the patient for as long as required and occasional adjustments will be made to increase normalcy of the joint. Some splints are meant for long term wear, such as certain leg and arm splints, and others will only be worn for certain hours. The type of splint and what the splint is correcting determines the amount of wear.

Overall each case is different so there are more general ideas for splinting instead of hard fast rules. Most "therapists believe that through daytime splinting, patients' splint adherence was better achieved due to enhanced comfort. Night splints … are prescribed to encourage functional movement … and allow sensory input during the day" (Adrienne and Manigandan, 2011). The variation in the splinting times allows for the greatest improvement in the patient without a much of a decrease in function due to the lack of movement and stimulation of the area. The overall goal of splinting is to "stimulate brain function by maximizing the functional length of both intrinsic and extrinsic muscles and by maintaining appropriate joint structure and function" (Pitts and O'Brien, 2008). The maintenance of the muscles and joints decrease the deterioration caused by non-use until strength is regained. Over time the use of the splint will "increase the potential for sensory-motor input, with the results of maximizing functional length and the … ability to do gross motor and fine motor dexterity tasks" (Pitts and O'Brien, 2008). The potential of the sensory motor input will allow for the sensation in the area to be maintained. The allowance of keeping muscles at the functional length will keep up the strength and increase the stability of the joint until movement can be restored to the joint.

Technology has allowed for many improvements in terms of splinting. Over time technology has increased the ease of splint formation and wear. Lighter and more comfortable material has been created which has caused an increase in splint use in

patients. The more that is learned about splints the more specific and helpful the splints themselves are. Overall the most important components of splints include keeping muscles stretched to maximal functional length, the ability to allow for sensory input, improving joint stability, and decreasing the deterioration of the joint and muscles themselves.

Neuromuscular Electrical Stimulation

One technological development that has had an impact on occupational therapy is the use of neuromuscular electrical stimulation to increase muscle strength. Muscle strength and tone is required to an extent for all daily activities. One easy way to recover lost muscle strength or just to increase overall muscle strength is to build muscle by small, constant repetitive contractions of the muscle, which is being used in neuromuscular electrical stimulation. The neuromuscular electrical stimulation device is attached to the patient using special conduction pads that create and sends small jolts of electricity to the muscle, which cause repetitive contractions of the muscles. Over time the strength of the electrical stimulation will increase to force a constant increase in muscle build. The repetitive contractions increase the use of the muscle therefore causing the muscle to be forced to increase in size and consequently strength. The increase in muscle strength allows the patient to have an increased ability for independent movement. This therapy allows the patient to build up lost muscle mass quicker then doing repetitive exercises. The quicker build of muscle allows for a more rapid return to independence for the patient.

Another way the neuromuscular electrical stimulation is used is to keep muscles toned that have been unable to be worked for multiple reasons. This therapy is used when

the patient has had an injury that is recoverable and the injury doesn't specifically affect the specific area. One case in which this is used is in brain injuries. When there is significant trauma to the brain and other nervous tissue deficits can appear. The noticeable deficits in the motility of various body parts is something that will try to be recovered to as high of a level as normal as possible for the patient. This requires for the patient's body and muscles to remain strong until the brain is able to heal, regain connections and overcome the deficit. The electrical stimulation is used on the muscles of the affect region of the body to keep the tone of the muscles so the patient doesn't have to regain strength in addition to recovering from brain injury, which allows an increase in the speed of the healing process.

A rapidly progressing field in terms of neuromuscular electrical stimulation is the idea to use electrodes placed on the skin to stimulate the muscles so that the person has the ability to use them. This is important for those with spinal cord injuries causing paraplegia. This technology would allow those who in the past had an irreversible injury to potentially gain the ability to use, for at least a short time, the ability of the paralyzed limb. The Food and Drug Administration (FDA) in the United States for both the upper and lower limbs currently approve the technology but the lower limb technology still needs to perfected (Sheffler and Chae, 2007). Even though the technology isn't fully developed yet it is still a very good work in progress and it shows the current ability of biomedical engineers.

Prosthetics

A major technological advancement that is changing occupational therapy is the increased realism of prosthetics. The realism of prosthetics is important because it allows

the person to be able to perform all the normal activities required for daily living. The more realistic the prosthetic is the easier it is for the person to acquire the technique required to use the device and the increased normalcy of the way the device functions. If the prosthetic functions nearly identical to the normal limb that was rendered nonfunctional then the ease of use would increase tremendously. The easier a prosthetic is to use the easier it will be for the individual to get use to using it and the more appreciation the individual will have for the device. If the movements capable to being performed with the prosthetic are approximately identical to the movement prior to non-functionality of the limb the more independence the individual will feel they have and the less adaptations that will need to be made to accomplish the previously known and learned tasks.

The improvements made to prosthetics include improved fit, life like realistic appearance, almost normal movement, durable material, and a decrease in energy exertion. The specific fitting process that uses the actual stump to fit the prosthetic causes the increased fit of prosthetics. The better the fit the less problems that will be caused by the prosthetic itself. Through the increasing abundance of technology it has become possible to motorize prosthetics, mainly hand prosthetics. The electronic prosthetics responds to nerve stimuli from non-movement muscles to allow certain movements to occur within the prosthetic. This allows for the person to control the prosthetic similar to their old limb and perform much of the same actions (Wavte, Dodd, MacDonald, Stoppard, 2010) which increases independence and mobility of the prosthetic. Another technological increase in prosthetics is the creation of more natural like movement ability in the prosthetic. This allows for lower limb prosthetics to have a knee and results in more natural control of the device (Esquenazi and Meier, 1996). The more control the person has over the prosthetic

the quicker the ability to use the device will occur and the less problems the device will cause. The more natural the device works the less energy that will need to be exerted for the person to complete the same task without the prosthetic. The better material for the prosthetics allows for an increased realism of the device and a more natural appearance. This allows for less of an obvious prosthetic appearance, which allows for less of a psychological impact due to the device.

Assisting Devices

A technological improvement that has altered occupational therapy is the creation and improvement of assisting devices. These devices include lift modifications for vehicles and houses, adaptation for houses and vehicles themselves, specialization of wheel chairs, the creation of speaking devices and improved hearing devices and voice recognition software and multiple other devices. Each of the device creations and improvements are based solely on technology and improving life for thousands of people. Everyone wants to be independent and creating technology that allows that is amazing. The specialization of the objects needed for everyday life allow for an increase in normalcy that helps the patients in a long-term sense. If a modification can be made to make life for the disabled easier there is someone working on it or it has already been constructed due to a need for the product.

The vehicle modifications made in terms of lifts and specialized driving adjustments have allowed for independence to be maintained or broadened. Some main vehicle modifications include lifts into and out of the vehicle, extended pedals, hand pedals and seat modifications. These modifications allows for vehicles to be driven in spite of any

obstacles that would make a normal car impossible to drive. The ability to drive a care is a huge step of independence in our society, which allows for less reliance on others. The decreases reliance on others allows for normalcy to return to the lives of injured persons and therefore increasing their quality of life.

Stimulus Control

Another ideal used in occupational therapy is the idea of stimulus control. Stimulus control is the use of various techniques to suppress over active stimuli receptors. This includes the use of pressure and weighted objects, which decompresses the nervous system and causes a subsequent relaxation. This is a common practice for children with autism. Autistic children commonly will become overwhelmed in certain situations causing an immense anxiety problem that is most easily decreased if continuous pressure is applied to large portions of the body. The pressure placed on the body stimulates the nervous system so that after an initial increase in anxiety the body will then relax. This technique is incorporated into occupational therapy by the use of weighted vests or clothing, "steam rollers" (which contraptions that have slightly weighted rollers on top and bottom and allow the person to move between the rollers) or simply hugging. Over time the goal of stimulus control is for the person himself or herself to be able to control anxiety themselves through various coping methods.

Another way occupational therapists have come up with to calm children with social disorders is to find an object or activity that calms them. This is something that varies from

person to person but normally it involves a specific sense. It is normally a simple activity that allows for self-soothing in the person. The simple activities attempt to decrease the inappropriate chosen soothing technique of the child. The ways that children are sometimes calmed include the use of pressure vests, rubbing backs, providing a location the child can go to that allows them to escape the stimuli and in older children teaching them to take deep breaths or count to ten to relax themselves. Finding an appropriate way to calm the person allows for more socially appropriate behavior and a greater acceptance into society.

Early Interventions

The best way to overcome a physical or cognitive impairment in children is to have early and structured interventions. The interventions include enrolling the child in adaptive school as soon as possible and allowing the use of different types of therapy as necessary. The sooner the interventions can be started the sooner the impairments can be worked on. The younger the child the more impressionable they are in terms of therapy and learning due to the fact that their brains are developing, which means the better the potential outcome will be. The earlier the treatment the easier it is for the brain to make the necessary adjustments to allow for the most normal of life experiences. It goes along with the idea that "genes provide the blueprint for building the brain architecture, but early experiences determine how the circuitry actually gets wired, and together they influence" the strength of the foundation (Shonkoff, 2009). This allows for children to have the ability to overcome some deficits as long as proper therapy is used to assist them.

Conclusion

Technology has altered the world we will live in immense ways, it allowed for the creation of a global society that is making advancements more rapidly then ever before. For the most part the technology has made lives easier, particularly in the field of medicine. Occupational therapy being a fairly new field has been able to use the technology available and expand it to fit the needs of the patients. The technological expansion has allow for better initial diagnosis, better and more useful splints, constant muscle stimulation, mild adaptations that increase the independence of patients, improved prosthetics, and better treatment of children with cognitive and physical impairments. The more that is learned about the human body, the more helpful and worthwhile the interventions will be. The increased improvements in terms of therapy allow the chance in overcoming the challenges brought on by everyday living for those with impairments that would not have been possible without receiving the therapy. The more the advances in technology and the more research done regarding therapeutic ideas the more people that will regain or gain the ability to perform more activities of daily living and perform their "occupations" then ever before. The ability to use the technology that is being developed comes down to the knowledge of the therapist, the willingness of the patient and overall determination and imagination of the two, which leads to great results.

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