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Assessment of the Change in State of Health in Reference to Different Postural Support Systems: Outcome of Research

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PREFACE

Becoming acquainted with the world of mobility equipment for me has meant that I learned to look differently at the disabled persons that I bump into on the street who are often in wheelchairs not adapted to their needs and with inadequate posture systems.

Each individual has his/her own identity and personality, therefore the needs become specific to the individual, and in the case of patients, it is the Occupational Therapist's responsibility to pinpoint the difficulties that a person has in carrying out activities and identify the mobility equipment that can support the residual abilities.

For this reason in choosing the mobility equipment it is essential to take into consideration different aspects, from diagnosis, to age, skin condition, cognitive level, possible deformities, use of orthoses, since every patient requires customized equipment.

The idea of this thesis originates in the Occupational Therapy department of the General Hospital of Rome Umberto I, where, on the occasion of the introduction into the market of the new cushion "Invacare Matrx Libra", we decided together with Ms. De Santis and Ms. Soave, Invacare's clinical manager, to compare and contrast it to two other posture cushions already on the market, to consider its strengths and weaknesses.

The choice was that of creating a protocol for the assessment of the posture systems and put at the center of the selection process the patient him/herself, by using the patient's opinion as means of choice, together with assessments through objective measurement tools.

INTRODUCTION

In the literature one of the aspects that stands out the most with regard to the use of wheelchair cushions is the prevention of pressure ulcers; in the different studies the focus is primarily on individuals with spinal injuries. [1-2-3-4]

A 2011 study revealed that air is the material that is most efficient in alleviating pressure on the supporting surface of the wheelchair. [5]

The question to ask is “do all people who use a wheelchair require an anti-decubitus air cushion?”, the answer, in our opinion, is “no”. In fact, there are some characteristics that, if present, can protect from the formation of bedsores:

- Preservation of sensitivity is the most important factor with regard to protection. He/she who has an incomplete spinal injury or is still able to feel pressure under the ischial tuberosities is undoubtedly better protected than those with a lack or loss of sensation. If anything, they are also better equipped to request a cushions which offer a higher level of protection should they sense excessive loading in any area.

- Good trophism in the gluteal area. If the buttocks are well “padded” (condition that is more common in robust individuals and in women), the chance of having a lot of pressure under the ischial tuberosities is reduced. However, it is very important to ensure that the skin is always in acceptable condition.

- Good mobility. The ideal position does not exist; there is no better protection for the skin than to frequently change postures.

An air cushion could always be supplied in any case, but it would be less stable than a simple posture cushion and it would require more maintenance.

Even though, in terms of postural control, in the static position in paraplegic individuals, no significant differences were observed among the various wheelchair seats (air-foam-polyurethane)[2], using different cushions can significantly influence the sitting balance During a dynamic activity, such as in the forward movement to seize an object.

For paraplegic individuals it was proven that a contoured cushion is able to increase the distance covered by the hand to reach the object and also the speed of the pressure center in

seizing the object and returning to the neutral position, all of this is in fact due to the cushion's contouring which promoted greater stability during the activity. [1]

Contouring can be generic or custom. Generic contouring is that of cushions that have a indentation for the pelvis and two lateral raised parts to load the greater trochanters. Individualized contouring is that of cushions modeled on the user. These cushions are produced individually, by making use of pressure survey equipment and a foam manufacturing computerized system. A measurement of the pressure distribution exercised on the cushion will never be able to be measured only in static since when one is seated he/she is subject to various adaptations and different postures, which vary according to the various activities carried out. [6] Therefore it is essential to note the dynamic pressure distribution. During the preliminary literature review it was identified in several studies as being an important factor in the prevention of pressure ulcers, and also ensure adequate postural distribution. [4-7-8-9] Specifically it was pointed out that pressure during dynamic movements is greater compared to pressure exercised in static [4].

The area where generally pressure ulcers develop is at the level of the ischial tuberosities [11]. However, the pressure peaks in the dynamic surveys do not coincide with these points during propulsion, therefore the movements of the ischium and the cyclical weight put on the tissue corresponding with the ischial tuberosities can have implications for the etiology of the pressure ulcers [12].

The use of a pressure mapping system is fundamental, as it is a tool, which can assist the therapist in the decision making process when considering factors related to the individual's sitting and posture in the wheelchair. By using this tool instant visual feedback is obtained, showing the uniformity of the pressure distribution on the supporting surface. It is crucial that this tool is used in both the static and dynamic state.

The different diagnoses can influence cushion choice as a 1997[13] study revealed, that measured the sittings of various cushions in conditions of static for the paraplegic group and other study groups with other pathologies, all this is probably due to the consequences caused by the pathology (neuropathy, sensitivity deficit, dystonia, tendon retractions…)

These results reaffirmed the importance of cushion-choice based on the individual's specific characteristics. It emphasized that a cushion-choice approach which was too broad and general was unlikely to lead to an optimal prescription for every individual. With this in mind, the study design was to include individuals with nonspecific pathology in the study sample,

ensuring a comprehensive framework covering the majority of pathologies found in individual who make use of wheelchairs for mobility. This study focus was to therefore to include individuals who had the ability to self-propel, and evidence how the prevention of pressure ulcers should not be the only criteria considered during the selection of an appropriate pressure cushion -through consideration of subjective factors such as quality of life.

This study was explorative and set out to determine the various characteristics which an “ideal posture system” should have, while placing the individual at the center of the selection process.

1. STUDY OBJECTIVES

1.1 Posture Systems of the Pelvis

For many years a simple blanket or some cushions were considered enough to decrease the sitting pressure and consequent risk of pressure ulcer formation. During the second half of the twentieth century, foam rubber was used to produce anti-decubitus cushions. Towards the end of the 60s if a person had specific needs tied to posture, especially in connection with sensorial deficits, he/she was given an anti-decubitus cushion, so as to limit risks from the prolonged seated position. The choice was limited to some materials: air, gel or foam rubber.

Only between the 70s and 80s were techniques developed that were also used to realize and maintain improved postural support.

In 1985 Nancy Mulholland, a physiotherapist, proposed the theory that a posture system could affect the muscle tone of children with Infantile Cerebral Palsy. From this initial approach, many researchers started to examine the effects which positioning and posture systems had on the pediatric population.

Many research programs, stemmed from the 60s, with the Thalidomide crisis. The Canadian government, in the attempt to find solutions for the complex and risky care of these children, developed four specialist centers. Therapists, doctors and engineers were employed in these specialist centers, where they worked together with the children and their families, with the use of technological resources. At the end of the 60s these operators had developed notable experience and obtained the mandate to study the needs of a larger
population of persons with disabilities.

The multidisciplinary composition of these groups of operators continued similarly until teams were formed that even today are used in rehabilitations programs.

Rehabilitation centers with multidisciplinary teams were the first to implement “seating clinics”. Posture systems were custom-built, and mounted to the wheelchair. They were comprised of multilayer wood and foam rubber, with metal supports.

The manufacture of a posture system was lengthy as the products were custom-made, and required significant skill to produce. In addition, these needed to look aesthetically pleasing.

While the seating clinics were developing and growing, many researchers and specialists, noted a surge in requests for posture systems for children with disabilities. For example, children with light or moderate hypertonus in conjunction with small orthopedic-related problems could be correctly positioned by using fixed planar components produced in different sizes. One of the first seating clinics to use the modular components of a posture system was the
Rehabilitation Engineering Research Center of the University of Tennessee, in Memphis. There, it was observed that many severely disabled individuals required a relatively similar posture system. The most obvious benefit of using the modular components remained the fact that even if the components were combined to be adapted to the single patient, the individual components were mass produced and readily available.

In 1975, seating specialists started to record the individual’s measurements in the seated position, as opposed to their measurements in lying, thereby simulating and factoring in the effects produced by gravity on the seated position.

Today, there are numerous posture systems and accessories, which can make keeping abreast with innovations, and choice a real challenge. Specialists and researchers need to continue to work together to meet the individual’s functional, physical or environmental needs through practical solutions.

Currently, wheelchair cushions can be divided into two broad categories:

- Anti-decubitus cushions
- Posture cushions

A cushion that is universally recognized as the best and most effective in the prevention of bedsores does not exist. Nor do specific indications exist by which the type of cushion to be

used is identified based on the user's pathology and other characteristics. The most appropriate cushion must be considered case by case.

The preventive qualities of an anti-decubitus cushion are linked to its effectiveness in its ability to decrease pressure under the ITs. To assist in the distribution of pressure, the cushion needs to be a system with qualities which encourage the boney protrusions to immerse thereby providing contact and support to a larger surface area.

One of the main characteristics of a posture cushion is to provide support and assist in maintaining postural alignment. This means that the posture cushion takes into account the individual's physiological parameters without overloading the neurological-muscular-skeletal system, optimizing function of the residual motor competencies.

The main cushions used are:
- Foam cushions
- Gel cushions
- Air cushions
- Foam cushions with air, fluid or gel inserts

Foam cushions are easy to manage, easy to find and their weight is within acceptable limits. It is important to select foam that is very elastic, of medium density and between 7 and 10 cm high, to provide adequate immersion of the ischial tuberosities. Foam is a material which has memory, therefore it is recommended for persons with unaltered skin sensitivity, and who can autonomously change position to distribute their weight on the support area. Foam is not a very breathable material, it warms up quickly, therefore open cell or perforated foams are preferred and especially the use of a waterproof but breathable cover.

Gel cushions in turn differ according to the type of gel they are composed of: silicone or polyurethane. The polyurethane has less memory. A decrease in memory and an increase in contact surface improve preventive effectiveness. Gel is not a good conductor of heat; therefore, it has the ability to remain sufficiently cool. The down side of these benefits are related to cushion weight, which may be in excess of 6 kg.

There are thermoplastic polyurethane cushions which are manufactured in a special manner which result in a honeycomb-like structure. These are then covered in a containment lining comprised of a knitted hypoallergenic and elastic-synthetic fiber. This material is able to resist pressure and distribute the weight uniformly over a vast area. This type of cushion requires

weekly maintenance as it must be immersed in water to recover the elastic properties of the material.

Air cushions have several variations to their design. There are some which only have one air chamber, and others which have several chambers that do not communicate with one another. There are also air cushions which have several communicating chambers. The more popular air cushions, are those with several communicating chambers. In this type, the cushion's shape corresponds to the body's anatomy and has ventilation as a result of the decrease in temperature at the support surface level.

Some air cushions have the ability to control the placement of air-quantity by making use of different chamber groups, which in turn adapt to the user's different needs. It is vital for air cushions to be adequate inflated for the individual's needs: too much air does not allow for a good immersion of the boney prominences; too little air allows for too much immersion, resulting in the boney prominences sinking until they touch the base of the cushion. Air quantity must be assessed, set-up and maintained for each individual.

Composite contoured cushions are comprised of both foam and fluids. They are designed with the intention of providing both anti-decubitus prevention and good postural stability. This is accomplished by means of the contoured-shape of the foam base (postural stability) and the anti-decubitus fluid which is placed on top of the contoured base (anti-decubitus prevention).

The fluid, which is contained in a sealed urethane bag, has no memory and allows for a good immersion of the boney prominences. Fluid is an effective medium in the prevention of shear forces, which may occur between the skin and ITs each time the person moves in the wheelchair. In fact, the ITs are free to move in the fluid.

The level of protection offered against pressure ulcers is proportional to the quantity of fluid. Cushions with a lot of fluid are indicated for those who are at high risk of developing pressure ulcers. Those with a thin layer offer less protection. With regard to air cushions, the composite contoured cushions (foam and fluids) provide a greater postural stability, even if they are heavier.

1.2 Choosing a Postural Support System

Selection of wheelchair seat cushions must be based upon assessment and consideration of the individual's needs.

The following elements need to be taken into account when selecting the posture system:

i. Age, the skin of the elderly and young population groups are more susceptible to pressure and their ability to manage it.
ii. Sensory deficit, individual with a loss or lack of sensation are at greater risk as they do not have sensation to provide feedback prolonged periods of sitting and the associated pressure.
iii. Mobility, an individual's ability to autonomously change their position and effectively off-load the support surfaces.
iv. Incontinence, will dictate the selection of material. As moisture levels increase, the risk of pressure ulcers increase.
v. Possible cognitive deficits which may limit the individual independent use of the posture system.
vi. Deformities observed during the postural assessment which must be corrected or accommodated within the posture system.

Each posture system must aim to provide the following, in addition to its preventive qualities:

i. Comfort
ii. Postural stability
iii. Appropriate weight for the individual to lift and manage independently
iv. Ease of maintenance
v. Functionality with regard to transfers

Comfort refers to the subjective assessment which is unique to the individual, based on their perception of their seated position. Comfort is directly associated with the extent to which the patient is able to tolerate sitting in the wheelchair.

Improved posture can lead to improved vital functions. Many individuals present with poor posture, which results in contracture and subsequently to permanent postural deformities. These individuals who present with deformities will require accommodation, as opposed to correction.

It is vital that a postural assessment be the first step toward understanding the individual's postural needs and whether accommodation or correction will be the pathway selected for intervention. The postural assessment, in most cases is conducted by an occupational therapist. Once the assessment results are analyzed the selection process can begin and the selection of either a permanent posture system and/or flexible support can be identified. It is of utmost importance that the assessment must include a physical assessment. The individual must be transferred from the wheelchair to a mat for the assessment. This enables accurate assessment of the mobility of the joints, spasticity, pain, retractions of the tendons and skin condition.

Improved posture can promote internal bodily functions such as breathing and digestive. The correct positioning for an individual needs to focus on maintaining or achieving horizontal gaze, thereby promoting social interaction and line of vision.

The cushion's weight must be within acceptable limits of the individual's ability to manage it autonomously, in addition, to it being compatible with the wheelchair's weight.

To provide appropriate load distribution the cushion's material must be soft, and not hard. Its reaction to deformity must be considered. If the deformation produced by the weight is elastic, meaning that if the cushion returns to its original form after removing the weight, the peak pressure reduction is not sufficient.

The result of insufficient deformation reaction, in the cushion will allow the ITs penetrate the elastic material, even density is low. The more the ITs penetrate the elastic properties the greater the amount of pressure on them.

To allow good load distribution, the pressure on the ITs must not be proportional to their sinking, meaning the cushion's deformation must be as possible. It is important to redistribute pressure to the areas which usually have less, and to reduce pressure from the skin covering the boney prominences.

In analyzing the process for the selection of a cushion, transfer methods must be taken into consideration. Transfers are considered an important part of autonomy. Therefore, selecting a posture system which promotes and maximizes the individual's residual motor competencies with regard to transfers must be seen as an important part of the selection process.

1.3 Study Objective

Each posture system has different characteristics, just as each user has different needs and priorities.

This study's main objective is to emphasize whether significant differences exist between a posture system and another, relative to occupational performance and how this change can modify the user's state of health and as a result his/her quality of life.

The study was based on a model centered around the individual and is often referred to as a client-centered approach. By keeping the individual the focus of all intervention and at the center of the process, this ensures that they are taking an active role in the selection process of their future equipment.

All study subjects recruited were able to contribute, who own a self-propelled wheelchair, were able to manage it autonomously and were independent in changing their positions and transfers.

The sample selection was recruited independent of the pathology since the objective is to categorize cushions based on their individual characteristics and highlight which posture system provided a good compromise with regard to comfort, pressure distribution, stability, posture, lightness, temperature, adaptability to movement and activities.

2. MATERIALS AND METHODS

2.1 Description of the Sample

The subject samples were recruited from March to September 2015 at the Occupational Therapy clinic inside the physiatrist department of the General Hospital of Rome Umberto I.

The subjects attended the department for an assessment of their mobility equipment following a physical examination. These subjects were approached on this occasion, and were given the option of participating in the study.
Consent was obtained from all study subjects for the use of their personal data, generic risks and complications that could occur (Attachment 1).

The inclusion criteria for study subjects, were are follows:

i. Independent use of self-propelled wheelchair
ii. Ability to move in the wheelchair autonomously
iii. Ability to carry out transfers without receiving assistance

2.2 Instruments used

2.2.1. BodiTrak and FSA system

The Boditrak package includes a mat which has integral sensors, computer software, and often a manual calibration kit. The Boditrak mat is comprised of a polyurethane material, nylon and Lycra stretchable material. The Boditrak mat is connected to the computer through a USB cable. It allows the user to scan, register, record, archive and share data collected by the sensors.

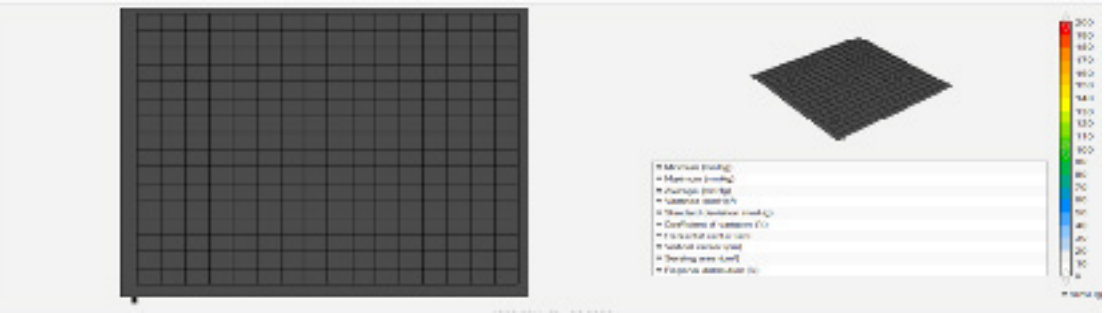
In order to use an FSA Boditrak system it is necessary to have access to a PC with an operating system post-Windows XP, USB entry and high-resolution graphics.

The system's graphics include a 2D representation, 3D representation, a table with statistical data, and a chromatic scale going from white to red. Values between 0 and 200 are assigned and correspond to millimeters of mercury with which the pressure is measured. White indicates minimum pressure and red maximum.

The mat must be connected to the PC and the individual must be positioned on the mat in sitting. Once the subject has been positioned the sensors will register the pressure on each of the sensors. The data registered will be: minimum pressure, maximum pressure, average between the various points of the sensor, variance, standard deviation, variation coefficient (in percent), horizontal and vertical pressure center (in centimeters).

In many cases, pressure-mapping systems are used as it is a tool which has the ability to provide real-time and valid feedback which plays a vital role in the prevention of pressure ulcers. It is able to measure areas of greater pressure and as a result the risk which the individual would be subjected to.

Below is an example of the graphics, without any pressure applied:



This, instead, represents a frame in static of the pressure a patient exercises on the cushion:

As can be noted through this measurement system all pressure peaks are shown with a numeric chromatic association, with an objective measurement that allows for identification of the material most suited to distribute pressure for each single study subject.

This measurement system is able to register pressure even for extended periods of time, by means of a video.

In this study the pressure applied by the study subject, was analyzed after 30 seconds of static sitting, and dynamic pressure was recorded during propulsion. For the dynamic pressure a recording of the pressure during propulsion was carried out for 40 meters. The data analyzed was at the point at which the study subject applied the maximum amount of pressure on the cushion.

2.2.2 Postural Assessment

Posture can be defined as “individual behaviors assumed by single persons, defined by

relationships that are established between various segments inserted in space and accompanied by relevant forces, specifically of the muscles, presided over by activity of control activity of the central nervous system" (Boccardi-Lissoni 1984).

Sitting posture, as with any other posture, presents easily describable invariant essential elements, characteristic of the type, with variable elements differing from one individual to another in relation to physical shape, possible presence of disabilities, particular chosen posture system, psychological state and socio-cultural factors.

To promote good sitting position, the following ergonomic principles must be observed:

- EFFICIENCY: since the seated posture constitutes a totality of conscious and voluntary actions, the mental effort required to maintain it must be reduced to a minimum in order to focus on the most meaningful aspects of the action.
    - In addition to the mental viewpoint, the seated posture must be economical from the physical viewpoint. The central nervous system and the posture system must aim to reduced effort through optimal alignment of the skeletal segments.

- COMFORT: the seated posture must be comfortable; the individual must not feel pain or paresthesia, bothersome tension or pressure sensations, or sensations of strain.

- FUNCTIONALITY: the seated posture must allow and promote maximum freedom of activity of the head and of the upper limbs, in addition, to maximum efficiency of physical and mental performance. Furthermore, it must not negatively interfere with the individual's physiological functions: digestion, respiratory, cardio circulatory function, and so on.

- ABSENCE OF SIDE EFFECTS: the seated posture must not cause secondary damage in the short or long term to various organs and systems. Specific attention must be paid to the prevention of pressure ulcers, contractures and/or deformities (scoliosis, pelvic rotation, club-feet etc.) and degenerative processes due to obsesity.

- STABILITY: in order for the posture to support the various functions it must be stable.

- AESTHETICS: even the aesthetic aspect of the seated posture has relevance by contributing to provide a positive image of one's self and increase self-esteem.

The fundamental requirements of a good seated posture are satisfied thanks to the interaction of internal (neuromotor system) and external (posture system) control mechanisms.
As seen, maintaining the seated position is guaranteed by automatic mechanisms and neuromotor control reflexes. The central nervous system, specifically, continuously adapts the seated posture to the motor task that the individual is carrying out so as to guarantee the best postural support and best dynamic stability; it controls the alignment of the skeletal segments,

and therefore the relationship between them and external forces, so as to allow maintaining the position with minimum waste of energy and minimum effort of the bearing structures; it allows, through frequent posture variations and continuous posture adjustment micro-movements, to distribute the exertions on the muscles and other supporting tissues in a balanced manner, thereby preventing dangerous static overloading. The seated posture is always impacted by, in addition to the internal mechanisms described above the support elements and the individual's control (posture system). The arrangement in space of the various elements of the posture system and their reciprocal relationships impact the seated posture directly or indirectly.

Any posture proves damaging if maintained for long, when talking about ideal posture one does not refer to a static state, but to a posture of reference around which the individual carries out constant adjustment movements.

Postural assessment is a route that is needed to standardize observation and measure results.

The first phase of the postural assessment consists in assessing the clinical situation and needs of the patient, by identifying a series of data that include the diagnosis, skin condition, possible surgeries, use or not of orthoses or braces, cognitive aspect, visual-auditory characteristics and how he/she carries out the transfers.

Thereafter, I observe the position in the wheelchair based on some parameters of reference that are:

- PELVIS: it must be aligned on three levels. The reference points are the upper, front and lower iliac spines. To consider the pelvis in neutral position the anterior upper iliac spines must be aligned on the frontal, sagittal and transversal plane. If this is not the case anteversion / retro version (sagittal plane), right rotation (transversal plane) or inclination left / right (frontal plane) will be encountered.

The position of the pelvis conditions in a crucial manner the structure of the spine and distribution of the exertions of the bearing structures.

- SHOULDERS AND UPPER LIMBS: the position of the shoulder girdle and upper limbs is conditioned by that of the spine. The shoulders, in the ideal resting posture, should be horizon tal, the elbows flexed at 90 degrees and forearms horizontal.

- TORSO: must respect normal physiological curves

- LOWER LIMBS: must be aligned and even, knees and ankles must be flexed at about 90 degrees.

Each deformity that is noticed can be the cause of the lack of a posture system, a lack of support on the trochanters, permanent deformities not sufficiently accepted or inadequate measurements of the mobility equipment.

Following adequate observation of the patient in the wheelchair, a transfer on a cot will be carried out and it will be assessed whether the deformities are postural non structured bad habits or structural bad habits, of a muscular or bone nature.

With regard to the assessment carried out during the study, on first examination a complete postural assessment will be done (Attachment 4) to reveal, reduce and, possibly, accept the deformities. Afterwards, for each cushion used, an observation will be done of wheelchair sitting after the activity, to verify how much stability the cushion is able to provide to the single user.

2.2.3 Questionnaire on state of health (SF-12)

The SF-12, in its version until now accredited in numerous languages, among them Italian, allows to describe the health of a group of people by making use of 2 questions for each of the following scales of the SF-36: physical activity, physical pain, general health, vitality and social activities- they are described with only one question each.

The questions have indexes regarding physical (PCS) and mental health (MCS).

For this study the questionnaire was modified, since the original researches the patient's state of health relative to the prior 4 weeks. Given that our interest lies in researching the state of health associated with cushion use, the patient was asked to answer each question relative to the week in which he/she tried the cushion (Attachment 2).

For each patient it will be distributed after each week the cushion is tried and it will be assessed how a pelvis posture system can or cannot modify the patient's state of health, from the physical and also mental viewpoint.

2.2.4 Questionnaire on patient satisfaction

To complete the posture systems assessment a questionnaire was formulated that puts the patient at the center of the choice process, by researching his/her opinion with regard to:

- Stability
- Temperature (perspiration and accumulation of heat)
- Adaptability to movement and activities
- Ease in wheelchair-bed / bed-wheelchair transfers
- Stability during limited personal hygiene (shaving/applying makeup, face washing and

tooth brushing).

For each parameter an opinion is requested comprised of the 5 choices below:

COMPLETEY SATISIED	FAIRLY SATISFIED	NOT SURE	FAIRLY UNSATISFIED	COMPLETELY UNSATISFIED

Furthermore parameters are taken into consideration such as diagnosis, use of orthoses or braces, daily average range of time spent in the wheelchair and modes of transfer (Attachment 3).

The questionnaire is an auto-filled questionnaire and is filled out by the patient at the end of the week after trying the cushion.

2.3 Cushions used for the study

The posture cushions used for the study are 3:
- ROHO Contour Select (Air)
- INVACARE MATRX LIBRA (Pre-shaped foam with bag in fluid)
- JAY BALANCE (Pre-shaped foam with bag in fluid)

ROHO CONTOUR SELECT (Air)

Complete air cushion, providing a high level of skin protection, together with the required positioning to improve stability. Cells are manufactured are neoprene rubber, covered with breathable, elastic and washable cover.

Its composition, in three levels, with cells of 10, 8 and 5 cm respectively are strategically arranged, to provide improved lateral stability on the wheelchair and allows the user to stay comfortably seated in the center of the cushion.

The ISOFLO MEMORY CONTROL, through the valve, isolates the air inside each of the four sections, thereby offering stability and minimizing the movements from one side to the other of the cushion (left / right and forward / backward).
With this type of cushion, it is possible for an individual to change posture with the patient

seated comfortably, without transfers. This air cushion is very light, and weighs approximately 1.7 k.g.

INVACARE MATRX LIBRA (Pre-shaped foam with bag in fluid)

This cushion has a base comprised of foam, with anatomical contouring to optimize pelvic support and positioning. The foam is very breathable, highly resistant.
In the ischial depression there is a double-layer bag of fluid with sealed compartments for maximum protection in proximity of the boney prominences.

It has two covers, the inner one is waterproof and water-repellent, the second is breathable with honeycombed-like structure.

This cushion offers numerous functional benefits among which is a pre-ischial block to prevent sliding, reducing shear forces, a trochanteric support which provides lateral stability to the pelvis, posterior contouring supporting the pelvis to prevent posterior pelvic tilt, a beveled waterfall front edge to provide clearance for propulsion with the lower limbs, and a contoured anterior shape which provides better control of adduction-abduction of lower limbs.
The fluid component ensures maximum protection for the boney prominences, while the contoured foam optimizes support and positioning of the pelvis.

For microbial, fungal and anti-odor protection the high quality foam is treated with Ultra-Fresh™. The cushion has a large range of accessories which make thePproduct highly customizable. With regard to weight it proves to be 40% lighter than the prior posture cushions of the Invacare range (about 1.6 k.g.).

JAY BALANCE (Pre-shaped foam with bag in fluid)

The Jay Balance cushion is comprise of a foam base contoured with closed cells. The femoral transition point and posterior edge help prevent the fluid from migrating, while at the same time providing a soft support to the trochanters and posterior part of the pelvis. The insert envelops the boney prominences of the pelvis, and provides maximum pressure distribution and maintaining skin integrity. Balance can be chosen with the JAY flow-fluid insert

or ROHO-air insert that adapt to the shape of each user, The material properties are designed to adapt to the sitting posture of the individual and provide adequate positioning of fluid or air under boney prominences to promote skin protection.
In this study, the Jay flow-fluid insert was used for all study subjects.

The cushion offers positioning components which can be inserted to correct deformities or provide the user with greater stability. The Jay Balance has a double cover, one internal and one external. The internal cover is waterproof, and easy to clean and dry. The Aqua-guard zipper and tear-proof thread ensure that the foam base stays dry. The external micro-climatic cover dissipates heat and humidity for additional skin protection. As an option, an additional external stretch cover, and one for incontinence are also available. All covers are machine washable at 60 degrees and dry very quickly. The elasticity of all new external covers makes allowances for positioning elements to be inserted without creating any surface-tension. Three types of covers are available: microclimatic, incontinence and stretch.

The weight of this cushion with Jay Flow-insert is approximately 2.4 k.g.

2.4 Assessment Protocol

The total period of the study was one month in total, with 4 meetings on a weekly basis. Between one meeting and another the study subject used the cushion supplied for that given week at his / her home, while carrying out his / her normal daily routine.
The three cushions were made available to the patient in random order.

The following is an overview of the intervention:

FIRST MEETING:

- Project presentation.
- Signing of informed consent regarding generic risks and personal data processing.
- Postural assessment in seated and supine position.
- First cushion test.
- Data collection on cushion pressure in static state.
- Data collection on pressure in dynamic state on

SECOND MEETING:

- compiling questionnaires relevant to the degree of satisfaction and health state for the cushion used during the test.
- second cushion test
- data collection on cushion pressure in static state
- data collection on pressure in dynamic state on a 40 m straight line

- observation of seated posture after the activity (recorded by photograph)
- supply of second cushion for the test

THIRD MEETING:

- compiling questionnaires relevant to the degree of satisfaction and health state for the cushion used during the test.
- third cushion test
- data collection on cushion pressure in static state
- data collection on pressure in dynamic state on a 40 m straight line
- observation of seated posture after the activity (recorded by photograph)
- supply of third cushion for the test

FOURTH MEETING:

- compiling questionnaires relevant to the degree of satisfaction and health state for the cushion used during the test.
- returning the cushion
- data collection on patient's opinions on various cushions used in the test.

2.5 Statistical Analysis

The various experiences with the three cushions will be compared, in terms of:

- Static pressure
- Dynamic pressure
- Postural assessment in seated position after the activity
- State of health
- Patient satisfaction with regard to use of cushions
- Subjective stability in seated position
- Constant temperature maintenance
- Adaptability to movement and activities
- Ease in wheelchair-bed / bed-wheelchair transfers
- Stability during the AVQs

For data analysis a team of Students will be used for multiple paired samples that will compare the use of 3 pelvis posture systems to the same initial sample.

The patients' satisfaction average will be taken into consideration following use of each cushion, change in health state, various pressures exercised on the cushion and how use of the same impacts wheelchair posture.

3. RESULTS

The sample recruited between March and September 2015 at the Occupational Therapy Service of the Umberto I General Hospital that fell within the criteria of inclusion is composed of 9 patients, of which 55% are males (5) and 45% females (4).

The average of the patients' age is 36,8 years with a 17,6 standard of deviation.

33% of patients use the wheelchair for less than 4 hours per day, 22% from 6 to 9 hours and 45% for more than 9 hours per day.

All patients provided informed consent for the Occupational Therapy and personal data processing.

NO	AGE	GENDER	DIAGNOSIS	DAILY TIME IN WHEEL-CHAIR	CONSENT
1	38	MALE	SPINA BIFIDA	MORE THAN 9 HOURS	YES
2	67	MALE	SPINAL INJURY	FROM 6 TO 9 HOURS	YES
3	14	FEMALE	FIBROMYALGIA AND CONNECTIVE TISSUE DISEASE	FROM 1 TO 4 HOURS	YES
4	44	FEMALE	MYSOSHI'S MUSCULAR DYSTROPHY	MORE THAN 9 HOURS	YES
5	19	FEMALE	SPINA BIFIDA	MORE THAN 9 HOURS	YES
6	57	MALE	SPINAL INJURY	FROM 1 TO 4 HOURS	YES
7	39	MALE	TCE WITH HEMIPLEGIA RESULT	FROM 6 TO 9 HOURS	YES
8	21	FEMALE	EHLERS-DANLOS SYNDROME	MORE THAN 9 HOURS	YES

PRESSURE READING

STATIC

Average pressure exercised on the three cushions after 30 seconds from sitting on various surfaces was measured.

Following the reading the following data were analyzed:

	Roho Contour Select	Invacare Matrx Libra	Jay Balance	Kruskal-Wallis test
Pressure Average (mmHg)	32,45 (DS 7,21)	31,35 (DS 10,53)	30,93 (DS 9,72)	0,879
Horizontal Pressure Center (cm)	21,13 (DS 1,65)	22,38 (DS 2,62)	21,51 (DS 2,35)	0,535
Vertical Pressure	22,76 (DS 5,05)	24,05 (DS 4,56)	23,68 (DS 4,38)	0,855

Pressure Average:

Jay vs Roho: 5%
Jay vs Libra: 2%

Horizontal Pressure Center:

Roho vs Libra: 6%
Roho vs Jay: 2%

Vertical Pressure Center:

Roho vs Libra: 6%
Roho vs Jay: 4%

DYNAMIC

Pressure exercised on the various surfaces during propulsion was recorded and moments of maximum pressure were analyzed, rejecting the remaining values.

Following the recording the following data were analyzed:

	Roho Contour Select	Invacare Matrx Libra	Jay Balance	Kruskal-Wallis test
Pressure Average (mmHg)	40,26 (DS 11,27)	40,85 (DS 12,75)	36,74 (DS 10,36)	0,603
Horizontal pressure center (cm)	21,76 (DS 1,49)	22,56 (DS 1,44)	21,93 (DS 1,49)	0,335
Vertical pressure center (cm)	24,20 (DS 4,87)	25,04 (DS 4,27)	23,68 (DS 4,83)	0,836

Pressure Average:

Jay vs ROHO: 9%
Jay vs Libra: 11%

Horizontal pressure center:

ROHO vs Libra: 4%
ROHO vs Jay: 1%

Vertical pressure center:

ROHO vs Libra: 2%
ROHO vs Jay: 5%

POSTURAL ASSESSMENT

AVERAGE ALIGNMENT OF PATIENTS

	ROHO	LIBRA	JAY
HEAD	100%	100%	100%
SHOULDERS	55%	88%	77%
TORSO	44%	77%	77%
PELVIS	11%	66%	55%
LOWER LIMBS	77%	77%	88%

SF-12

PCS (Concepts relevant to physical morbidities)

ROHO	LIBRA	JAY	Kruskal-Wallis test
34,42 (DS 10,29)	38,76 (DS 8,89)	35,84 (DS 11,16)	0,490

Libra vs Roho: 12%
Libra vs Jay: 8%

MCS (Morbidities and psychological and mental etiologies)

ROHO	LIBRA	JAY	Kruskal-Wallis test
53,16 (DS 4,01)	56,52 (DS 7,01)	46,87 (DS 8,05)	0,058

Libra vs Roho: 6%
Libra vs Jay: 18%

SATISFACTION

TOTAL QUESTIONNAIRE

ROHO	LIBRA	JAY	Kruskal-Wallis test
21,66 (DS 4,47)	24,22 (DS 3,45)	22,66 (DS 4,03)	0,395

Libra vs Roho: 11%
Libra vs Jay: 7%

STABILITY

ROHO	LIBRA	JAY	Kruskal-Wallis test
3,22 (DS 1,20)	4,22 (DS 0,97)	4 (DS 0,70)	0,098

Libra vs Roho: 24%
Libra vs Jay: 6%

TEMPERATURE

ROHO	LIBRA	JAY	Kruskal-Wallis test
3,88 (DS 0,60)	4 (DS 1,22)	3,88 (DS 0,60)	0,624

Libra vs Roho: 6%
Libra vs Jay: 22%

ADAPTABILITY TO THE ACTIVITIES

ROHO	LIBRA	JAY	Kruskal-Wallis test
3,66 (DS 1,22)	3,88 (DS 1,16)	3,44 (DS 1,13)	0,624

Libra and Roho vs Jay: 6%
Libra vs Jay: 22%

TRANSFERS

ROHO	LIBRA	JAY	Kruskal-Wallis test
4 (DS 1,11)	4 (DS 0,70)	3,77 (DS 1,30)	0,938

Libra and Roho vs Jay: 6%

STABILITY IN SPEED

ROHO	LIBRA	JAY	Kruskal-Wallis test
3,44 (DS 1,13)	4,22 (DS 0,66)	4 (DS 0,70)	0,229

Libra vs Roho vs: 19%
Libra vs Jay: 6%

STABILITY DURING THE ADLs

ROHO	LIBRA	JAY	Kruskal-Wallis test
4 (DS 1,13)	4 (DS 0,78)	3,55 (DS 0,72)	0,542

Libra and Roho vs Jay: 12%
Libra vs Jay: 9%

4. DISCUSSION

In considering the data, no statistically significant differences were observed among the 3 cushions in any of the research areas, however, with the application of a Kruskall- Wallies test for the independent samples results greater than or equal to 0,05 emerged.

Nonetheless, though the statistical test considered the average of the single values, the study had intended to analyze how the averages of the values produced a clinical significance.

With regard to pressure exercised by the users on the cushions it emerged that a foam cushion has better pressure distribution. For the horizontal and vertical pressure center the hypothesis present in the literature in which an air cushion is considered the best in preventing pressure ulcers is
confirmed.

All 3 cushions did not significantly change the posture from before to after the activity. If the single bodily elements are analyzed, considering that the pelvis represents the essential element for the user's stability in the wheelchair, it is observed that 11% of the patients maintain a pelvis alignment with a Roho cushion (air).

Overall the cushion that modifies the patients' posture the least after the activity is the Invacare Matrx Libra cushion.

After these considerations, it can be deduced that an air cushion will be excellent in preventing pressure ulcers but it would prove to provide less stability than a foam cushion.

Amongst the SF-12 results in the various cushions there are no statistically significant differences, since the comparison between the average single values produced proves to be greater than or equal to 0,05.

For physical morbidities, the Matrx Libra cushion clinically proves better able to improve the patients' state of health, by 12% compared to Roho and 8% compared to Jay.

Instead with regard to concepts concerning morbidities and psychological and social etiologies, the highest score still is Matrx Libra's, but in this case by 6% compared to Roho and 18% compared to Jay.

An important part of this study was to consider the individual's satisfaction, in addition to the objective data, in addition, to consider the individual's well-being in the use of one cushion over another.

No statistically significant differences were produced since all the results produced a result greater than or equal to 0,05.

However, for all the questionnaire's items, patients showed gretater satisfaction in using the Invacare Matrx Libra cushion compared to the other two.

Considering the data analyzed, for this study the cushion that proves to be a good compromise with regard to ease, pressure distribution, stability, posture, lightness, temperature and adaptability to movement and activities is the Matrx Libra.

5. CONCLUSIONS

In the study it emerged that the three cushions that were analyzed proved all to be excellent solutions for users of self-propelled wheelchairs. More likely in order to understand the subjectivity of the choice of the posture systems, the research sample would have to be larger, since a small and heterogeneous sample, does not allow for the observation of differences that are statistically significant.

However, in addition to assessing the prevention of pressure ulcers and posture, understanding the patient's perception in remaining seated, considering the adaptability that the cushion provides to him/her with daily activities and general satisfaction relevant to well-being and health state should be required, by considering all of the impacting factors such as the individual's needs, together with the occupational therapist's experience, and the findings of the objective assessment instruments, it is unquestionable that this will lead to optimal decision-making when selecting a posture system for the individual.

ATTACHMENTS

- Attachment 1: Informed consent
- Attachment 2: Modified SF-12 (Italian version)
- Attachment 3: Questionnaire on wheelchair cushion satisfaction
- Attachment 4: Postural assessment form
- Attachment 5: Example of clinical case

Faculty of Medicine and Dentistry Degree Course in Occupational Therapy Seat of Rome

Attachment 1: Informed Consent

Last name_____First name_____
Born in_____Prov._____on_____
Residing in_____Prov._____Zip code_____
Street_____no._____
Cell_____Email_____
Medical Diagnosis_____

The Occupational therapy intervention for this study on the change of state of health after using different pelvis posture systems consists of 4 stages:
- Pressure survey on the various cushions through a pressure survey mat
- Postural assessment after the documented activity with digital photographs
- Compilation of a questionnaire on state of health (F-12) and one on the user's satisfaction.

Generic risks:
- Pain symptoms;

Specific complications:
-The occupational therapy treatment does not involve specific complications, but only some generic risks, since it does not have an invasive effect on the patient; but it bases rehabilitation on daily life activities, such as: self-care, work and leisure.

I undersigned_____ declare that I was informed, even based on that which I reported in the history, that I understood the terms, modalities, purpose and nature of the rehabilitation specified in the form. I declare that I am aware of the risks and complications that could originate from the treatment. Furthermore, I am aware that without my collaboration and availability in following some behavioral rules, indicated by the toccupational therapist, the therapy cannot be
considered effective. I give my full consent to the rehabilitation and therapies that were described to me, by undergoing the rehabilitation treatment for the required time.
Date_____Patient Signature_____
Consent to processing of personal and sensitive data (Leg. Decree 196/2003)
I undersigned_____born in _____on_____
residing in_____Via_____no.____

AUTHORIZE

In accordance with Legislative Decree 196/2003 the research group in the persons of Mariele Colucci, Maria Grazia Soave, Giovanni Galeoto and Rita De Santis to process personal and sensitive data and images exclusively for research purposes.
Date_____ Signature_____

Faculty of Medicine and Dentistry Degree Course in Occupational Therapy Seat of Rome

Attachment 2: Modified SF-12 (Italian Version)

INSTRUCTIONS: This questionnaire intends to assess what you think of your health. The data collected will allow us to always be up-to-date on how you feel and your ability to carry out your usual activities.

Answer each question of the questionnaire by indicating your answer as shown in each instance. If you are not sure how to answer, make the best selection.

1. In general, you would say that your health is:

1	2	3	4	5
Excellent	Very good	Good	Fair	Failing

The following questions concern some activities that you could carry out in the course of any one day. Are you currently limited by your health in carrying out these activities?

	Yes, I am very limited	Yes, I am partially limited	No, I am not at all limited
2. Moderate physical effort activities, such as moving a table, using the vacuum cleaner, playing bocce.	1	2	3
6. Climbing a flight of stairs	1	2	3

In the past week, did you encounter the following problems while at work or in other daily activities, due to your physical health?

	YES	NO
4. You were not as productive as you would have liked	1	2
5. You had to limit some types of work or activities	1	2

In the past week, did you encounter the following problems while at work or in other daily activities, due to your emotional state (such as feeling depressed or anxious)?

	YES	NO
6. You were not as productive as you would have liked	1	2
7. Your concentration at work or while carrying out other activities decreased	1	2

8. This past week, to what extent did pain prevent you from carrying out usual work (inside and outside the home)?

1	2	3	4	5
Not at all	Very little	A little	A lot	Very much

The following questions pertain to how you felt this past week. Answer each question by choosing the answer that most resembles your case. For how long this past week did you feel…

	Always	Almost always	A long time	Some of the time	Almost never	Never
9. calm and serene	1	2	3	4	5	6
10. full of energy	1	2	3	4	5	6
11. discouraged and sad	1	2	3	4	5	6

12. In the past week for how long did your physical health or emotional state interfere in your social activities, with family, with friends?

Always	Almost always	A long time	Some of the time	Almost never	Never
1	2	3	4	5	6

Attachment 3: Questionnaire on satisfaction of wheelchair cushion

QUESTIONNAIRE

1. Age (years):

2. Gender:
   - ☐ Male
   - ☐ Female

3. Diagnosis:
   - ☐ Loss of lower limb (Amputation)
   - ☐ Myeloid lesion
   - ☐ Dystrophy
   - ☐ Multiple sclerosis
   - ☐ Other (specify) _____

4. Which posture unit do you currently* make use of?
   - ☐ Torso (back)
   - ☐ Pelvis (cushion)
   - ☐ Torso-pelvis (back and cushion)
   - ☐ None

   *Specify posture system model if used (air, foam, etc.) _____

5. In which facility did you benefit from the pelvis posture unit, provided during the week of testing?
   - ☐ Hospital
   - ☐ Nursing home
   - ☐ Rehabilitation Center
   - ☐ Hospice
   - ☐ Domicile
   - ☐ None of the above

6. Do you make use of lower limb orthoses or mobility equipment that appear to modify your wheelchair posture?
   - ☐ Yes
   - ☐ No

7. Within which time-range does average time spent by you in the wheelchair fall?
   - ☐ From 1 to 4 hours
   - ☐ From 4 to 6 hours
   - ☐ From 6 to 9 hours
   - ☐ More than 9 hours

8. How do you make the transfers?
   - ☐ Autonomously without mobility equipment
   - ☐ Autonomously with mobility equipment
   - ☐ With assistance
   - ☐ With hoist / verticalization system
   - ☐ None of the above

9. Provide your opinion on the following cushion in terms of:

- STABILITY:

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

- Constant TEMPERATURE maintenance:

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

- Adaptability to movement and activities:

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

- Ease in wheelchair-bed/bed-wheelchair TRANSFERS:

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

- Stability in TRAVELING SHORT DISTANCES ON A STRAIGHT LINE AT SPEED (40 m):

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

- Stability during LIMITED PERSONAL HYGIENE (shaving/applying makeup, face washing and tooth brushing):

Completely satisfied	Fairly/Rather satisfied	Unsure	Fairly/Rather unsatisfied	Completely unsatisfied

Attachment 4

POSTURAL ASSESSMENT
OF THE O.T.

Date:_____
Physician of ref.:_____
DIAGNOSIS:_____

PERSONAL DATA

Last name_____First name_____
Born in_____Prov._____on_____
Residing in_____Prov._____Zip code_____
Street_____no._____
Cell_____Email_____
Local Health Agency_____
Professsion_____
Living situation: Family ☐ Institute ☐

GENERAL PATIENT DATA:

Base muscular tone:	hypotonia ☐	hypertonia ☐	dystonic movements ☐
Skin sensitivity:	normal ☐	hypoesthesia ☐	hyperesthesia ☐
Decubitus lesions:	absent ☐	present ☐:	reddening (stage I) affecting skin tissue (stage II-III) affecting muscle tissue (stage IV)
Skin allergies:	no ☐	yes ☐	
Muscle pain:	absent ☐	present ☐	
Visual deficits:	no ☐	yes ☐	likely ☐
Auditory deficits:	no ☐	yes ☐	likely ☐
Circulatory deficits:	no ☐	yes ☐	
Respiratory deficits:	no ☐	ascribable to base pathology ☐ ascribable to incorrect posture ☐	

NEUROLOGICAL PROFILE

Lesion:
paraplegia ☐ tetraplegia ☐ double hemiplegia ☐ hemiplegia: right ☐ left ☐

Torso control:
no ☐ yes ☐

Cognitive abilities:
intact ☐ light deficit ☐ medium deficit ☐ serious deficit ☐

Communication with the patient:
verbal ☐ sign language ☐ impossible ☐

Swallowing:
normal ☐ dysphagia: pureed diet or semi-liquid ☐ PEG ☐

Urination and defecation:
normal ☐ uses a commode ☐ incontinent with diapers ☐
carries out catheterization ☐

Epileptic crises:
no ☐ yes ☐

CURRENT MOBILITY EQUIPMENT AND MODE OF USE

For mobility:

WHEELCHAIR:
standard ☐ light ☐ super light ☐ sports ☐ external base ☐ internal base ☐

Operation:
manual ☐ self-propelled ☐ operated by others ☐ electric wheelchair ☐

For how many hours a day does he/she use the wheelchair:
less than 4 hours ☐ between 4 and 10 hours ☐ more than 10 hours ☐

Where does he/she use the wheelchair:
outside ☐ inside ☐ only for long distances ☐ always ☐

ASSESSMENT OF CURRENT WHEELCHAIR SITTING

HEAD	
SHOULDERS	
TORSO	
PELVIS	
INFERIOR LIMBS	

ASSESSMENT OF PATIENT IN THE SUPINE POSITION FOR OBSERVATION OF THE ROMS

LONGITUDINAL ALIGNMENT
Pelvis Posterior Tilt

Pelvis Anterior Tilt

Pelvis Obliquity

Pelvis rotation

HIP RIGHT LEFT

Bending

Extension

Abduction

Adduction

Extra rotation

Intra rotation

KNEE	RIGHT	LEFT
Bending		
Extension		
Ischial crural tension		

ANKLE	RIGHT	LEFT
Dorsal bending		
Plantar bending		

Attachment 5

CLINICAL CASE I
Years: 67
Diagnosis: Spinal cord injury
Gender: male

POSTURAL ASSESSMENT AFTER THE ACTIVITY

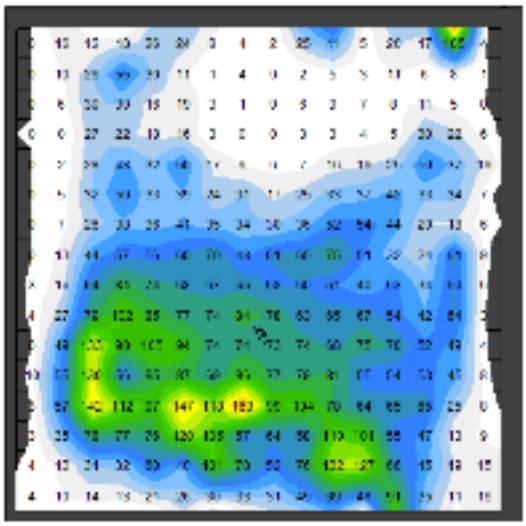
[photo of patient in wheelchair]	Cushion	ROHO CONTOUR SELECT
	HEAD	Aligned
	SHOULDERS	Not aligned (right is higher)
	TORSO	Scoliotic behavior
	PELVIS	Pelvic obliquity
	LOWER LIMBS	Abducted
[photo of patient in wheelchair]	Cushion	INVACARE MATRX LIBRA
	HEAD	Aligned
	SHOULDERS	Aligned
	TORSO	Aligned
	PELVIS	Aligned
	LOWER LIMBS	Abducted
[photo of patient in wheelchair]	Cushion	JAY BALANCE
	HEAD	Aligned
	SHOULDERS	Aligned
	TORSO	Aligned

PELVIS	Aligned
LOWER LIMBS	Aligned

PRESSURE SURVEY

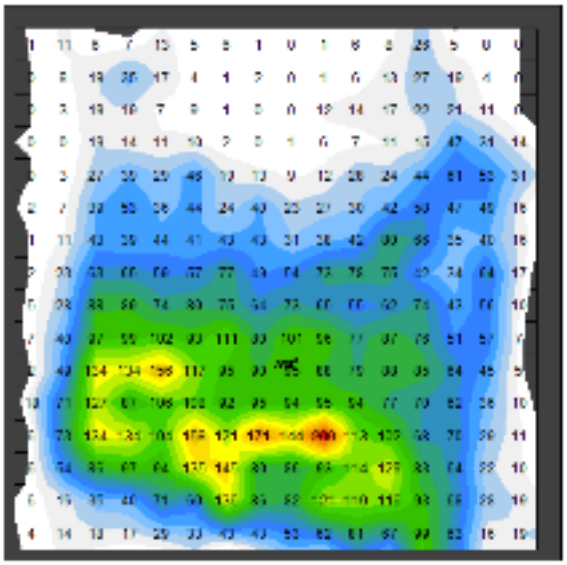
ROHO CONTOUR SELECT (Air)

Static after 30 seconds of sitting



Average: 40.77 mmHg
Horizontal pressure center: 23 cm
Vertical pressure center: 28.39 cm

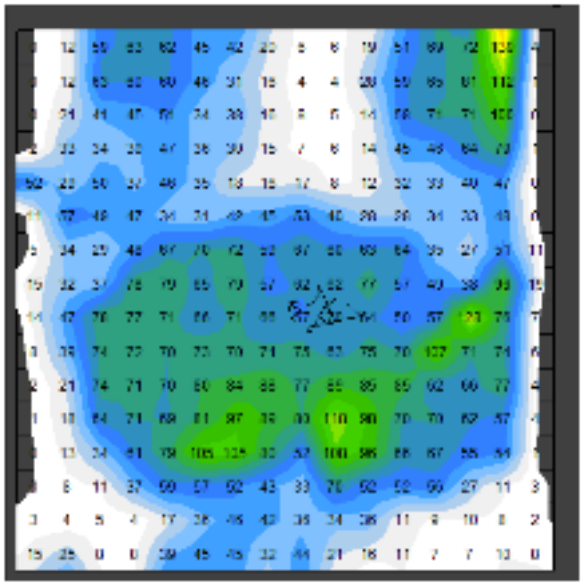
Moment of highest pressure during propulsion



Average: 41.74 mmHg
Horizontal pressure center: 21.06 cm
Vertical pressure center: 30.31 cm

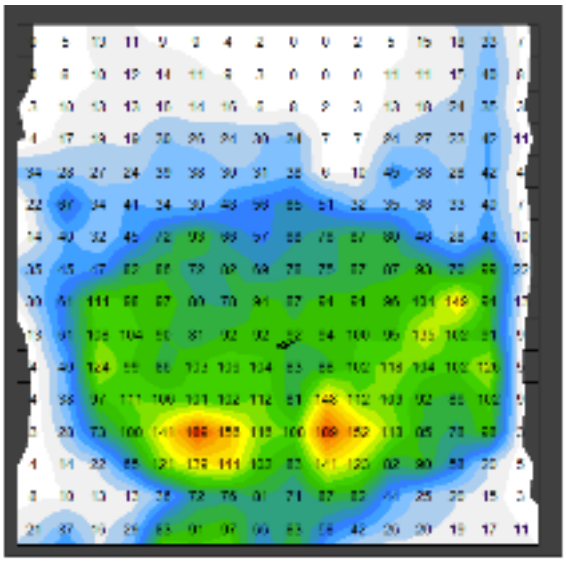
INVACARE MATRX LIBRA (Foam with insert in fluid)

Static after 30 seconds of sitting



Average: 44.49 mmHg
Horizontal pressure center: 21.86 cm
Vertical pressure center: 23.02 cm

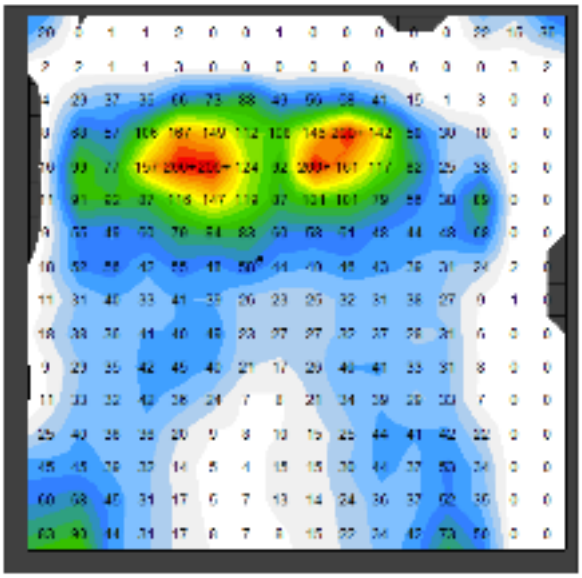
Moment of highest pressure during propulsion



Average: 53.11 mmHg
Horizontal pressure center: 21.74 cm
Vertical pressure center: 28.47 cm

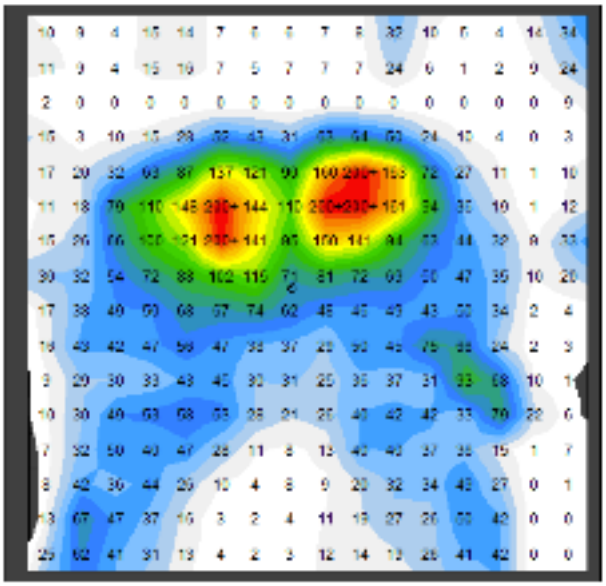
JAY BALANCE (Foam with insert in fluid)

Static after 30 seconds of sitting



Average: 36.24 mmHg
Horizontal pressure center: 20.37 cm
Vertical pressure center: 24.36 cm

Moment of highest pressure during propulsion



Average: 35.02 mmHg
Horizontal pressure center: 20.15 cm
Vertical pressure center: 25.90 cm

SF-12 RESULTS

	PCS	MCS
ROHO CONTOUR SELECT	28.1	50.3
INVACARE MATRIX LIBRA	41.8	66.2
JAY BALANCE	28.3	45.4

Satisfaction questionnaire results

	ROHO CONTOUR SELECT	INVACARE MATRX LIBRA	JAY BALANCE
STABILITY	3	5	4
TEMPERATURE	3	5	3
ADAPTABILITY TO MOVEMENT	3	4	4
TRANSFERS	3	4	3
STABILITY DURING PROPULSION	3	4	3
STABILITY DURING THE A.D.L.S	3	4	3
TOTAL	18	26	20

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