Report

Clinician Arm Support by Adept Medical, New Zealand.

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About us?

The ergonomics department of the Universidad de Concepcion was founded in 1972 and has developed in the field of teaching, research, technical assistance, and dissemination of ergonomics since then. The Ergonomics Department has a staff of highly trained professionals with experience in ergonomic evaluation processes, both for products and processes.

Ergonomics evaluation of Adept Medical products

Brief background

Adept medical Company have identified ergonomic and workflow advantages in their products that we would benefit from independent studies on. This information could be referenced in marketing communications.

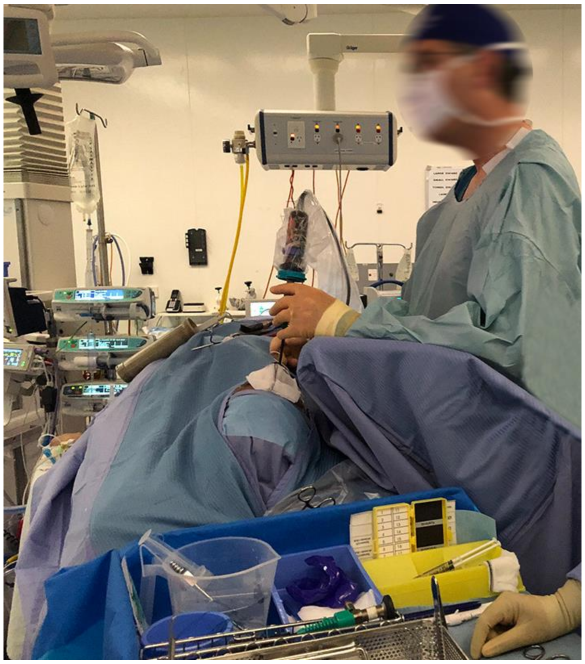
The Ergonomics Department of University from Concepción is designed to carry on the independent studies.

1. Introduction

Standing posture is an essential and everyday function in human life, especially for healthcare professionals who spend long hours working in this position. In the medical field, maintaining proper posture is not only crucial for the physical well-being of patients, but it also has direct implications for the health and performance of the physicians themselves. However, despite its importance, a deep understanding of standing posture in the medical setting and its impact on the health of professionals has been an under-explored field of study.

Rhinology, a branch of otolaryngology that focuses on the diagnosis and treatment of nasal and sinus diseases, involves medical procedures that demand extreme precision and proper ergonomic posture by healthcare professionals. Rhinology procedures are often performed while standing, which can lead to musculoskeletal strains in physicians due to inadequate support. Ergonomics in the surgical setting is essential not only for the well-being of healthcare professionals, but also for the quality and safety of patient care.

Figure 1 - Rhinologist standing and operating.



This study aims to address the issue of ergonomics in rhinology procedures, focusing on the influence of the use of an arm support during these procedures. The use of an arm support could potentially improve physicians' posture and reduce muscle fatigue and joint stress. To assess these effects accurately and objectively, three cutting-edge biomechanical assessment techniques will be applied: Baropodometry, Oscillography and Kinematics.

Baropodometry, will reveal how body weight is distributed across the feet during procedures, which is essential for understanding stability and load on the lower extremities. Oscillography will be used to measure postural oscillation and evaluate stability. Kinematics will allow for an analysis of posture and movements during rhinology procedures.

The results of this study are expected to measure the effectiveness of introducing an arm support in rhinology procedures from an ergonomic perspective. This research could not only contribute to improving the health and well-being of healthcare professionals, but it could also have a positive impact on the precision and quality of patient care in the field of rhinology. The results are expected to provide a solid foundation for making informed decisions about ergonomics in this critical medical setting.

Objectives

Main objective general

To compare rhinology procedures performed while standing, with and without an arm support using advanced biomechanical assessment techniques.

3. Materials and Methods

3.1 Techniques used.

3.1.1. Baropodometry: Used to measure the distribution of pressures on the sole of the foot. Baropodometry, can be performed statically or dynamically. In static baropodometry, the subject stands on a pressure platform for a few minutes. The platform measures the pressure at specific points on the sole of the foot. Baropodometry provides information on a variety of factors, including the distribution of pressures on the sole of the foot, which was evaluated in this study.
The expected values in a Baropodometry, vary according to the age, sex, and level of physical activity of the patient. In general, it is expected that the distribution of pressures on the sole of the foot will be symmetrical, with most of the body weight supported on the forefoot and heel. In healthy people, the distribution of pressures on the sole of the foot is usually as follows:

- Forefoot: 40-50% of body weight
- Heel: 30-40% of body weight
- Longitudinal arch: 20-30% of body weight

3.1.2 Oscillography: Used to measure postural stability. This means that when the subject has poor standing posture, they will have greater variability in muscle activity when standing. Thus, increasing the subject's fatigue. Poor standing posture will impact negatively in both the neck and lower back muscles.

3.1.3: Kinematics: Used to analyse posture and movements during rhinology procedures. The study of human motion is a branch of biomechanics known as kinematics. Kinematics specifically studies just pure motion and not the actual forces which cause the motion. The likely results are related with keeping the body and their parts within expected angles to avoid musculoskeletal problems.

3.2 Subjects:

Three non-clinical subjects were subjected to training to perform tasks in a setup like that used in clinical wards. The subjects' heights were between 1.60m and 1.80m. Two men and one woman were considered.

3.3 Protocol:

A Clinician Arm Support (CAS) was tested. The Clinician Arm Support by Adept Medical, corresponds to an arm support that is easily installed on the operating table. This support allows for regulation in different conditions. For this study, the hand holding the Endoscope device should remain over the face of the subject, the position of the support device should not promote lumbar flexion or any discomfort to the operating subject.
The protocol considered a baseline assessment, without the use of Clinician Arm Support (NO-CAS) and with the use of Clinician Arm Support (CAS), called CAS. For each condition, two captures were performed.

Note: The basal position is independent of the use or not of the CAS. Since the main point of the study is compare the differences of NO CAS with the use of CAS. However, in some of the subjects the procedure position, with or without CAS, could be better than the basal position.

3.4 Positions:

- Basal: Considered the anatomical position with the person in a bipedal position with the arms at the sides.
- Clinical Position: Established as the subject in a bipedal position, with their feet comfortably and naturally placed, normally with a distance like that of the shoulders.
  - NO-CAS: Considered the clinical position, but without the arm support.
  - CAS: Considered the clinical position with the use of the arm support.

3.5 Assembly:

The assembly was carried out in two stages, in the Ergonomics laboratories of the Department of Ergonomics of the University of Concepción, Chile. The first opportunity allowed the research team to receive feedback to correct postures and elements typical of the medical discipline. The second instance was carried out under the supervision of an external team to validate the clinical posture of the subjects, as well as the posture of the test patient.

3.6 Equipment:

The equipment used was a Baropodometry and Oscillograph from Sensor Medica (Italy), which has 4 sensors per square centimetre. The oscillography was performed under a 60-second protocol following scientific recommendations (no noise, no instructions, no interference, no prior consumption of coffee or stimulants, etc.).
The kinematics was performed with high-speed cameras that allowed recording at 330 FPS.

4. Results and Discussion

As mentioned before, the purpose of the study was to evaluate the use of the CAS, therefore, it is important to observe the results between the use of NO CAS with the use of CAS.

In some of the subjects the use of CAS could even better than the basal position, but it is not the focus prove that.

4.1 Baropodometry

There were three main results of the baropometry evaluations. The first was the distribution of weight between the left and right foot. The surface area of both feet on the ground and the distribution of weight between forefoot, longitudinal arch, and heel.

Table 1 shows the weight distribution for the three subjects. The ideal distribution is 50% between the left foot and the right foot. Three situations were tested: basal, NO CAS operation position, and CAS operation position.

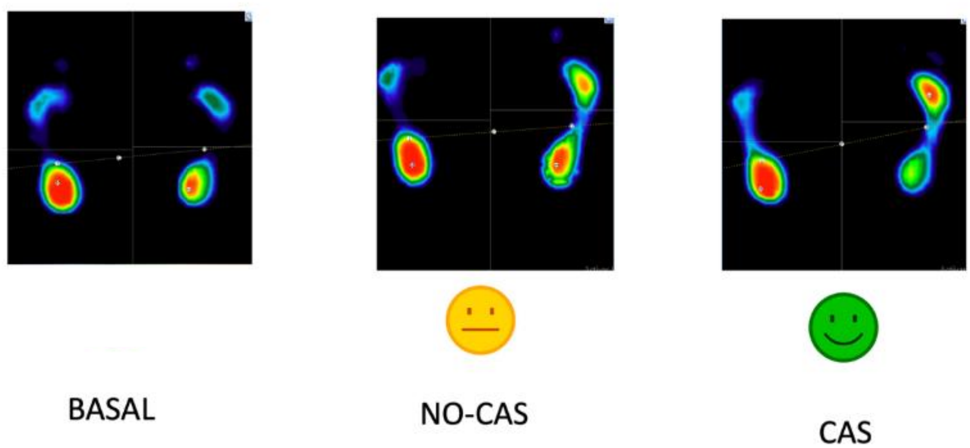
Table 1. Weight distribution between left foot and right foot with basal posture, NO CAS operation, and CAS operation.

	Weight distribution between left foot and right foot		
Subject.	**Basal (% of weight)**	**NO CAS (% of weight)**	**CAS (% of weight)**
1	58% L / 42% R	47% L / 53% R	51% L / 49%D
2	54% L / 46% R	57 L / 43% R	48% L / 52%D
3	47% L / 53% R	58%L / 42% R	54% / 46% D
Average	**53% L / 47%R**	**54%L / 46%R**	**51%L / 49%D**
SD	**3.9-**	**4.3**	**2.1**
Difference with the ideal distribution	**+3/-3**	**+4/-4**	**+1/-1**

In all three subjects the use of CAS improves the weight distribution between the feet, therefore, also the average distribution is better with CAS, 51% for the left foot and 49% for the right foot, versus 54% for the left foot and 46% for the right foot without the CAS. This action is favourable since the installation of CAS in the upper body can naturally improve the distribution of weight on the feet of the subject. In percentage terms, the use of CAS improves between 4% and 7% the optimal ratio of weight distribution, versus the use of NO CAS.

Regarding the evaluation of feet area resting on the floor, more area means more area to support the body weight. In relation to the weight distribution in each foot, the following ratio is ideal: Weight distribution in the forefoot: 40-50% of body weight, heel: 30-40% of body weight; and longitudinal arch: 20-30% of body weight.

Figure 1. Body weight distribution, forefoot, longitudinal arch, and heel, using Baropodometry for Subject 1, evaluated. Base position, NO CAS operation and CAS operation are compared.



In subject 1, figure 1, there is an improvement in the feet area resting on the floor. In the case of NO-CAS total surface was 185 cm2. In the case of CAS was 190 cm2, the improvement area was 2.7%.

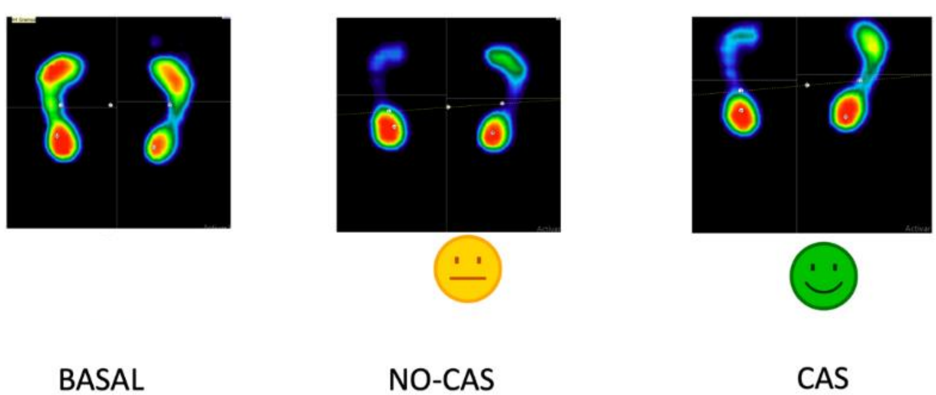
Table 2. Results of body weight distribution for forefoot, longitudinal arch, and heel: using Baropodometry for Subject 1 evaluated. Base position, NO CAS operation and CAS operation are compared.

Weight distribution	Ideal percentage of body weight distribution*	Basal *(Percentage Weight distribution)	NO-CAS * (Percentage Weight distribution)	CAS * (Percentage Weight distribution)
Forefoot:	40-50%	18%	33%	44%
Longitudinal arch:	20-30% of body weight.	7%	19%	27%
Heel:	30-40% of body weight	75%	48%	29%

*Average value considering both feet

An improvement of surface area of the foot resting on the floor is observed with the use of CAS. Also, the weight distribution is closer to ideal, especially in the case of the left foot around the arch with CAS.

Figure 2. Body weight distribution, forefoot, longitudinal arch and heel, using Baropodometry for Subject 2, evaluated. Base position, NO CAS operation and CAS operation are compared.



In subject 2, figure 2, there is an improvement in the feet area resting on the floor. In the case of NO-CAS total surface was 187 cm2. In the case of CAS was 191 cm2. The improvement area was 2.1%.

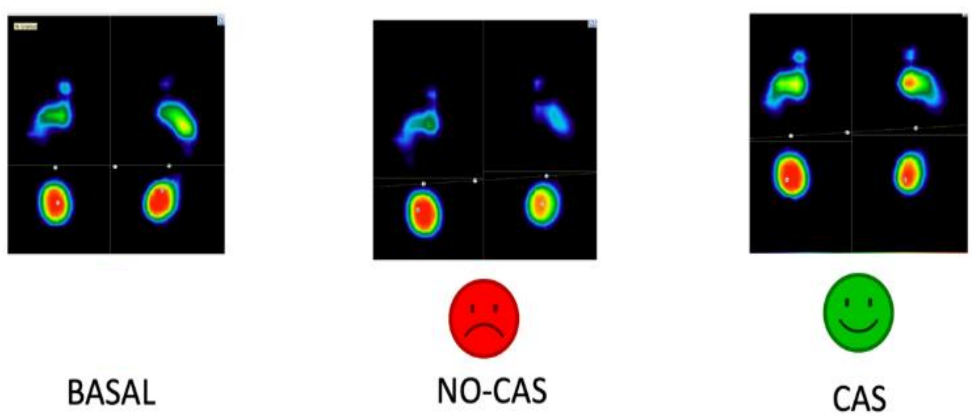
Table 3. Results of body weight distribution for forefoot, longitudinal arch, and heel, using Baropodometry for Subject 2 evaluated. Base position, NO CAS operation and CAS operation are compared.

Weight distribution	Ideal percentage of body weight distribution*	Basal *(Percentage Weight distribution)	NO-CAS * (Percentage Weight distribution)	CAS * (Percentage Weight distribution)
Forefoot:	40-50%	40%	19%	35%
Longitudinal arch:	20-30% of body weight.	30%	12%	18%
Heel:	30-40% of body weight	30%	69%	47%

*Average value considering both feet

In subject 2, there distribution closer to ideal. Improves the forefoot and arch area on both feet, especially in the case of the right foot when using CAS.

Figure 3. Body weight distribution using Baropodometry for Subject 1, evaluated. Base position, NO CAS operation and CAS operation are compared.



In subject, figure 3, there is an improvement in the feet area resting on the floor. In the case of NO-CAS total surface was 165 cm2. In the case of CAS was 184 cm2. The improvement area was 11.5%.

Table 4. Results of body weight distribution for forefoot, longitudinal arch, and heel: using Baropodometry for Subject 2 evaluated. Base position, NO CAS operation and CAS operation are compared.

Weight distribution	Ideal percentage of body weight distribution*	Basal *(Percentage Weight distribution)	NO-CAS * (Percentage Weight distribution)	CAS * (Percentage Weight distribution)
Forefoot:	40-50%	23%	18%	32%
Longitudinal arch:	20-30% of body weight.	8%	6%	3%
Heel:	30-40% of body weight	69%	79	65%

*Average value considering both feet

A larger surface area of the foot resting on the floor and a better distribution, with the use of CAS. Also, it improves the area mainly of the forefoot and heel.

4.2 Oscillography

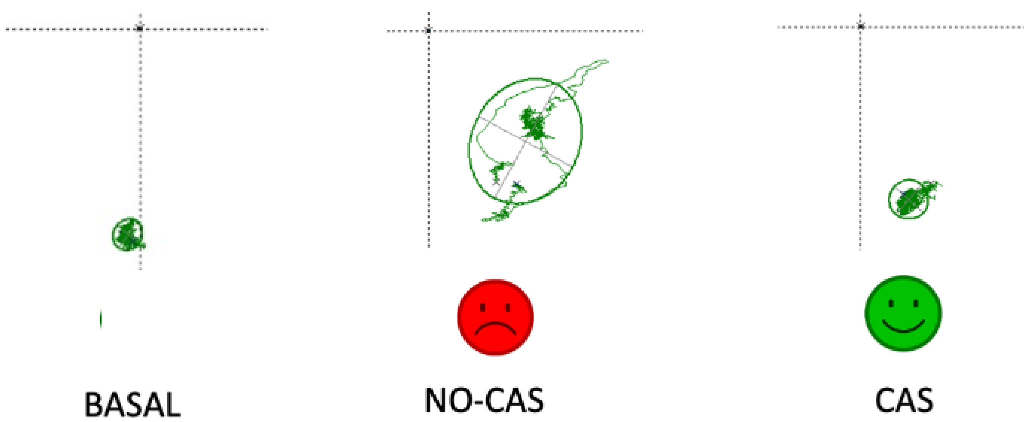
As mentioned, when the subject has poor standing posture, they will have greater variability in muscle activity during standing posture. As mentioned before, the purpose of the study was to evaluate the use of the CAS, therefore, the focus is to observe the results between the use NO CAS with the use of CAS.

Table 5. Results of the Oscillograph size of the ellipse (mm2), for all the subjects

Subject.	Basal (mm2)	NO CAS (mm2)	CAS (mm2)
1	23.06	166.51	5.09
2	81.31	35.56	6.53
3	4.56	16.46	8.45
Average	**36.31**	**72.84333**	**6.69**
S. D	**32.7**	**66.6**	**1.3**

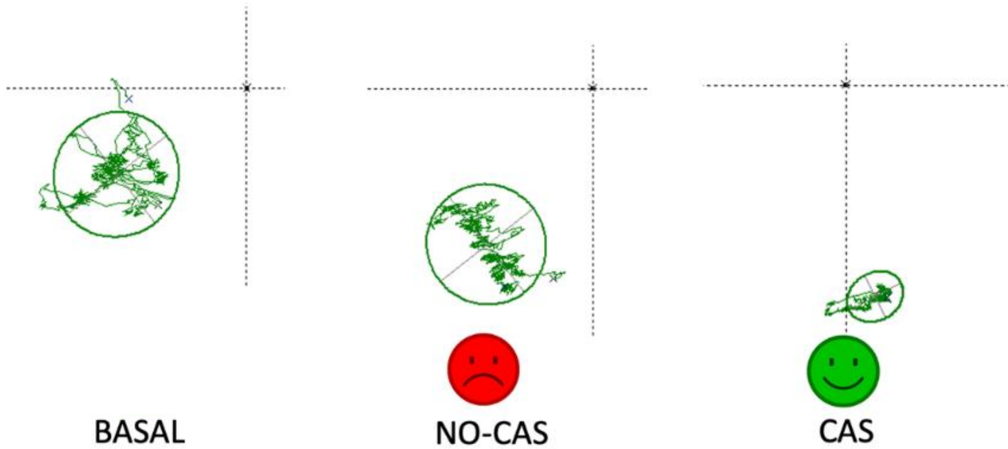
The results of the oscillograph are significant and very clear. Percentage-wise CAS improved postural control with respect to NO-CAS. For subject 1 to 166.5 mm2 to 5.09mm2 (96.9%), for subject 2 from 35.56mm2 to 6.53 mm2 (81.7%) and subject 3 from 16.45mm2 to 8.45 mm2, (48.6%).

Figure 4. Results of the Oscillograph size of the ellipse (mm2), for subjects 1



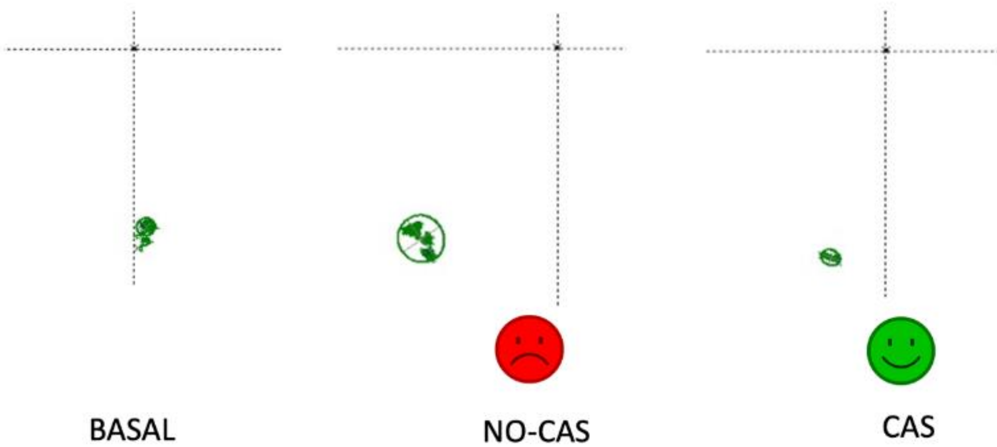
For subject 1, figure 4, The shape of the basal circumference is relatively maintained when the subject occupies CAS. This is a good indication of the lower trade-offs that the motor control system must make to maintain position. CAS improved postural control by 96.9% compared to NO-CAS.

Figure 5. Results of the Oscillograph size of the ellipse (mm2), for subjects 2



For subject 2, figure 5, The basal circumference shape is improved since decreased when the subject occupies CAS. In percentage terms, the use of CAS improves postural control by 81.7% compared to NO-CAS.

Figure 6. Results of the Oscillograph size of the ellipse (mm2), for subjects 3



The shape of the basal circumference remains similar when the subject occupies CAS. In percentage terms, the use of CAS improved by 48.6% compared to NO-CAS.
9% in respect to NO-CAS.

4.3 Kinematics

In postural terms, with focus on the angles of the neck, elbow, radial and ulnar deviation, and wrist extension, due to the way of working, body sizes, technique, experience, the differences between the use or not of the arm support, does not present significant differences.

Where there are differences is that the use of the CAS allows the isometric contraction maintained by elbow flexors to be supported which is both beneficial and important, especially in long-term activities such as the one the arm support was designed for.

A second advantage is that in the case of the wrist, the use of CAS tends to protect the participation of wrist extensor muscles, especially in maintained isometric contractions, which can prevent extensor tendon pathologies. In the wrist-hand, decreasing wrist extension, and supporting radial deviation.

Finally, participants mention that there is less muscle tension in the neck and shoulder area when using CAS.

5. Conclusions

The use of Clinician Arm Support by Adept Medical, New Zealand, demonstrated ergonomic improvements over the usual clinical procedure without support, based on a baropodometric methodology, with the use of oscillography and kinematics.

It can be concluded from the baropodometry results that the weight distribution between left foot and right foot, showed improvements of between 4% to 7% in the redistribution of plantar pressures in favour of Clinician Arm Support. It also improves weight distribution, approaching an ideal between the forefoot, longitudinal arch, and heel. All of this means less fatigue for the clinician, since it is revealed that the body weight is distributed better across the feet during procedures, which is essential for better stability and an improved load on the lower extremities.

The oscillography results show improvements in balance and postural control improve between 49% and 97% when using Clinician Arm Support. The results mean that subjects that use CAS have better standing posture, showing the lowest muscle activity in the neck and back muscles. This means a lower likelihood of muscle fatigue during a procedure.

Kinematics have shown that using the CAS improves the isometric contraction maintained by elbow flexors. Also, the use of CAS protects the participation of wrist extensor muscles, which can prevent extensor tendon pathologies. Wrist extension is also decreased, and radial deviation supported in the wrist-hand.

The participants of the study, mention that there is less muscle tension in the neck and shoulder area when using CAS.

It is not the purpose or scope of this study to identify protective factors of injuries, however, the good results obtained and the knowledge of biomechanics and ergonomics, allow us to recommend the use of the device as an element of personal protection that favours both the comfort of the doctor, as well as the prevention of musculotendinous pathologies.