
The Cane: Mechanical or Sensorial Support?

Almada, F.^{1*}, Fernando, C.² & Vicente, A.³

¹*Retired University Professor / Independent Researcher, Portugal*

²*University of Madeira - CITUR, Portugal*

³*University of Beira Interior, Portugal*

***Correspondence to:** Dr. Almada, F., Retired University Professor / Independent Researcher, Portugal.

Copyright

© 2020 Dr. Almada, F., *et al.* This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received: 23 July 2020

Published: 31 July 2020

Keywords: *The Cane; Exoskeletons; Muscle Work*

Researching is not measuring. Researching is to find useful answers to interesting questions.

The ability to collect data, to accumulate and transmit information, and to massacre that information until we get the answers we want, has grown exponentially in the past tens of years and will continue to increase explosively.

But interesting answers to important problems don't follow.

In this way, knowledge is discredited, knowledge is ignored, wisdom is despised. Once again, potential wealth was transformed into a burden.

Classic Supports to Displacement

Before exoskeletons invade man's life (among many ways to create a cyborg) we have to analyze some traditional supports to the movement of man, trying to understand the services they provide and the costs they have (there are always costs, financial and others).

We have nothing against the use of all available resources that can help man to fulfill his designs or even his dreams. However, we often let ourselves be enchanted by the nearby brightness and forget that everything has costs that will always be paid... in time. Nowadays reality is increasingly virtual. The critical sense and the ability to select is (at least apparently) increasingly superficial (there is no time, no desire to get to the bottom of the issues; issues that become more and more complex and profound).

We must slow down a little to make an exercise of reflection in a manifestation of common sense, which, we think, may justify its cost in time (and others).

Introduction

It is known that elderly people with mobility difficulties after falling for the first time fall again quite frequently and increasingly withdraw to face situations that can be considered “dangerous”.

The use of a walking stick, a cane or other types of support can facilitate the avoidance of a tendency towards immobility, which results in an ever-greater loss of ability to act until limiting the elderly to bedridden or a wheelchair.

Although answers empirically found to be satisfactory, such as the use of a cane, a crutch, a walking stick, or a walker, it is important to understand the root causes of this situation to improve performance in training and adaptation to the answers to this problem and also so that more efficient action strategies can be developed.

A cane, from a mechanical point of view, is an inefficient instrument, especially when it is used by someone who has a shaky hand and with little capacity to exert a force with any precision. But won't the cane predominantly have another function?

The Cane

The tendency, in research, to take the risk of trying to “not take risks” (which comes from positivisms that are today only valid in restricted areas), does not facilitate the answer to a question in this open way. But, on the other hand, finding answers to particular situations, however many these situations may be, also does not allow us to find satisfactory answers. [Note: an image, which is not meant to be seen literally, although it is literally right - mathematics says that a straight line is composed of an infinity of points, but they also say that two points can define a straight line - but who cares about mathematics? Especially because the line in this reasoning is not straight and there is always the risk to have only a finite number of points, as is done in any graph, and need to extrapolate to a line that we accept].

We will try to overcome this difficulty with a methodology that starts from three problems that we believe to have meaning for the issue that we raise and seek that from the conclusions drawn in each of them, and see if we have achieved a meaningful synthesis.

For an Analysis of the Use of the Cane

In order to understand the use of a cane, we cannot fail to address three perspectives on the subject: 1- the performance of man (that is, here, the relation of the positions of the center of mass and the support base, to

make a force on the exterior or, b - either to move); 2 - the operation of a cane (in a kind of “reverse engineering” - to check the optimization of the process); 3 - realize that muscle work is not done by exercising a “pure” force, but by a set of impulses with feedback and readjustments.

The conclusions to be drawn must involve these three aspects in order to understand the functionality of the whole and the existing dynamics.

Three Problems

- 1) The relation of the positions of the center of mass and the support base.
- 2) Functional analysis of the use of a cane.
- 3) Muscle work in the exercise of strength.

We Know That

1) The Relation of the Positions of the Center of Mass and the Support Base

Looking to be brief let's see the following basic schemes:

A - Exerting a Force on the Outside

We have to solve two problems: 1- compensate the reaction force to the force exerted; 2 - have friction at the level of the support (soil) so that we do not slip due to the force of reaction of the exerted force:

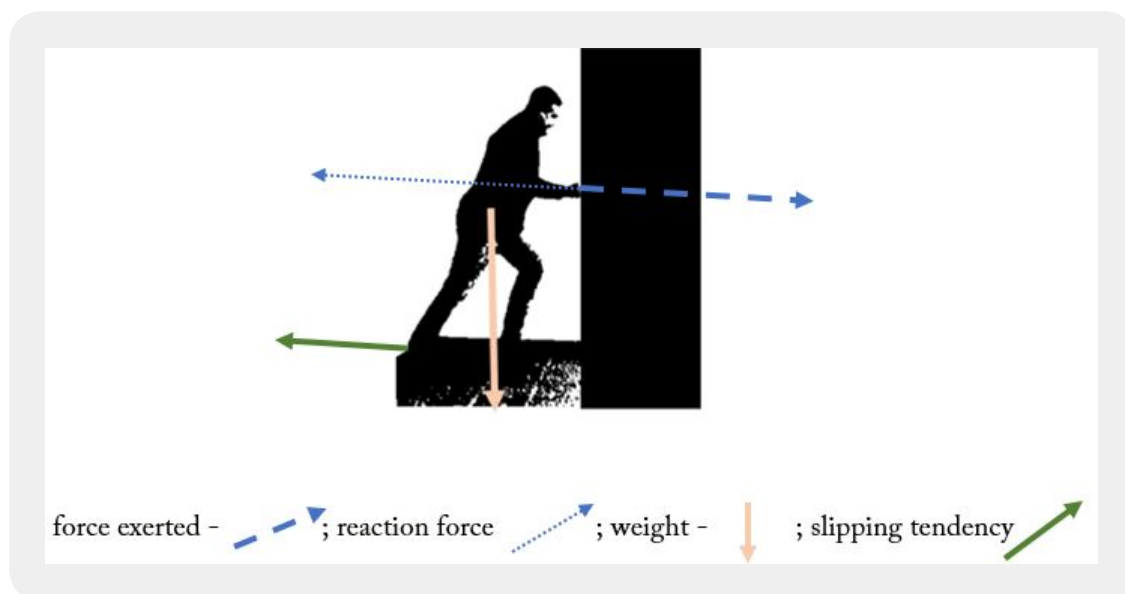


Figure 1

We Withdraw That

- It is the relative position between the placement of the center of mass and the support base that allows us to use the action of our weight to compensate for the effects resulting from the force we intend to exert;
- In sport, interpreting an opponent's actions to optimize their positions allows us to gain precious hundredths or even tenths of seconds for the performance obtained [1].

B - Displacement

We have to solve 1 again - the problem of creating a bond (friction many times) at the level of support; 2- obtain a reaction force to the force exerted on the support in order to obtain the desired displacement.

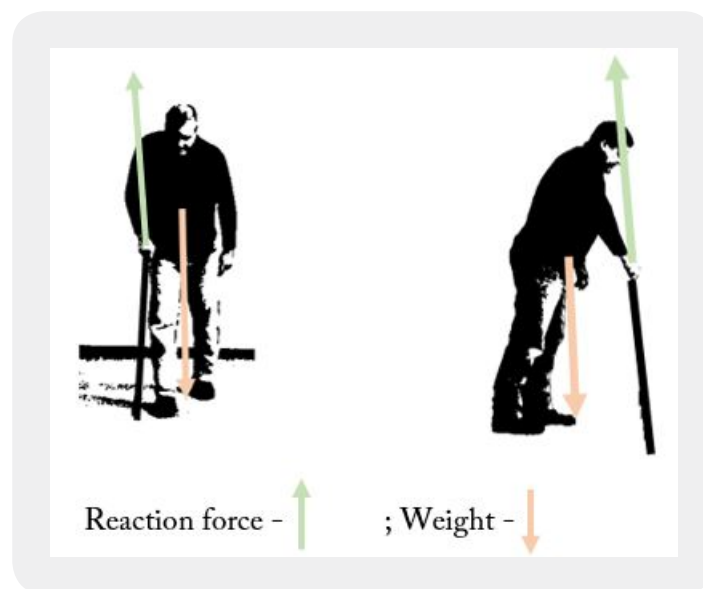


Figure 2: If the forces considered are not aligned, the effect will generate a torsion

We Withdraw That

- It is the relative position between the placement of the center of mass and the support base that allows us to use the action of our weight to regulate the effects resulting from the force we intend to exert, but we have to compensate the existing torsion effect;
- The cane can be used to modify the support base and / or find new strength to help balance the set. But it can also provide information on the progress of the process, especially if the natural sensors (at the level of the foot, lower limbs, the sensitivity about the placement of the center of mass, with or without vision support...) encounter some difficulty (age, injury, etc.);
- The cane allows to collect information and modifies the support base. It also allows the feeling of unbalances, etc. to regulate this whole process. But it hardly allows to obtain a force with meaning for the displacement;

- Again, in sport, the interpretation of an opponent's actions to optimize their positions allows us to gain precious hundredths or even tenths of seconds for the obtained performance [1].

2) Functional Analysis of the Mechanics of Using a Cane

If we analyze the previous images, even without making complex mechanical analyzes in which the different forces mentioned above are identified, it is easy to see how the torsions resulting from the action of the weight and the support of the cane on the ground imply a complicated work of the different segments to achieve a minimally acceptable balance.

We Withdraw That

- If from a mechanical point of view the cane is an inefficient support, especially if it is being used by a person with some coordination difficulties;
- But as a sensor it can be extremely useful, fulfilling the function that people look for on a ladder in support of a handrail or when looking for contact with a wall not to look for a support but to gather information that facilitates balance and provides security.

3) Muscle Work on Strength on an Unstable Surface

Although, for ease of use, the force exerted at the joint level is considered to be a "pure" force, represented by a vector, in reality there is always a set of effector actions, with multiple readjustments and actions of support, compensation and stimulation, as we can verify if we try to interpret what happens in the following situations:

- Placement of an individual on a platform of forces, in the "simple" situation of trying to be standing still - however no matter how much training or great is the performance (to any best level sportsman of any sport) the projection of the center of mass on the platform is never, nor near, a point, which shows that it cannot be still;
- Moving on a "soft" surface (for example grass) is more costly from an energy point of view due to the compensations it requires;
- If we isolate the action of the lower limbs (see figure 3) we verify that the maximum force made on an unstable surface (a mattress) never reach the values obtained on a rigid surface.

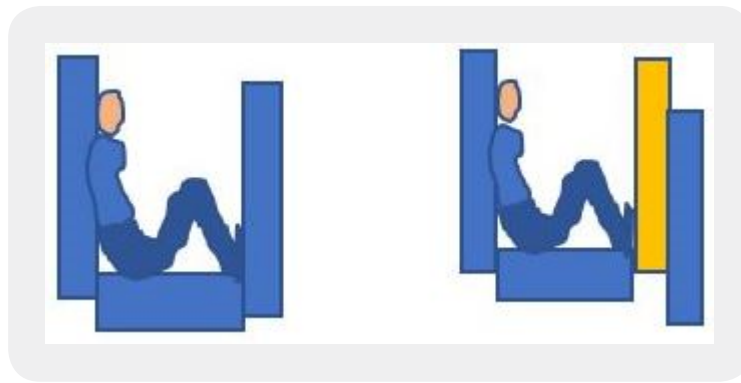


Figure 3: *With a mattress we can only make a smaller maximum force*

We Withdraw That

Although at the level of this exhibition it is not essential to consider all the complexity of the functioning of a joint, or sets of these, we must not forget that the phenomenon is complex so that we do not fall into basic conclusions that we often have difficulty coming out even when it is necessary to think processes more deeply.

To Finish

Some will say that nothing has been said that any well-informed person should not know. We agree. But the well-informed people are not as many as would be desired and thus we establish a basis for dialogue that we might otherwise not have guaranteed.

Except maybe:

- That the cane is possibly more a sensor than a mechanical support, which is not clear from the consultation of existing documentation on the subject, whether produced by researchers or by the manufacturers of canes themselves;
- That there are strategies for functionality in the performance of muscle action at the local level (joint, set of joints, or set of segments), strategies that are changed by adaptations, sometimes just in a few minutes;
- That when the use of models of functionality, simple, but adjusted to the problems addressed, allows, with reasonable costs, to draw interesting conclusions for the understanding of the phenomena involved.

We Emphasize

➤ From the beginning, we reported that we were not looking for answers at the punctual level, but rather to seek to structure more global responses that had a functional meaning. Structuring investment may not pay immediately, but in addition to providing stability, it is often profitable in the medium term;

- Cyborgs, exoskeletons and the analysis of human movement by artificial intelligence are already common, but do not yet dominate “the market”. The understanding of human movement by human intelligence with the use of functional models can allow simple and useful results before (urgent, therefore) that algorithms render situations ineligible by “ordinary intelligence”. The same goes for the relationship between virtual reality and “real reality”(?)
- Sport, when properly structured and with a working system, is a privileged field of study of the functionality of man because it makes massive investments (by the number of the sample involved, by the effort put in) in extreme situations (the champion aims the limits). Thus, it can be an interesting partner in the study and investigation of man’s functionality due to the support it can provide and the sensitivity it offers in relation to non-typical situations;
- One example: Judo and swimming are extreme situations in the strategies of joint work. In judo, the appropriate blocking of joints at impact (frequent) protects both segments and internal organs. In swimming “softness” in muscle performance “saves” energy and boost performance. We cannot talk about sport in general, as we cannot talk about medicines as if they were all the same, we need to understand the active principles, the prescriptions we must make with them, the effects we should expect... etc. - or else we lose the sense of what a sport... and a medicine, can do, and the interest they can have;
- The study and understanding of the different performance strategies at the articular level, given the requests that are made in the different sports modalities can allow to improve the specific training to respond to the problems experienced, to avoid trauma by the use of adapted responses or to understand the causes and forms of the injuries suffered;
- Understanding the functionality of man (as a whole and not only in particular aspects) allows establishing how to enhance his defense mechanisms and how to complement them with protective equipment. However, these two forms of action can be contradictory, the excess of some preventing the development (or the atrophy), or the expression, of the others. See, for example, how the use of shoes with very soft soles can remove some of the aggression at the level of the joints of the foot, but it certainly goes to the demands that have to be compensated at the level of the ankle or knee.

Conclusion

There is a wide field of dialogue between different areas of knowledge, with enormous advantages for their complementarities, if useful bridges are found and it is understood that the evolution of each of them in their specific fields enhances the overall performance and the appearance of situations where applicability is possible, because the different forms of intervention are mastered that dealing with concrete always requires.

Note: to measure, if in itself it is not research [today the ability to measure “anything and everything” is practically infinite, with degrees of precision that defy the imagination] because in itself it is just collecting data, it can be a mean of promoting dialogues around common interests, and of serving as a “stubborn streak” that allows to refute positions, which is essential in any discussion in the field of science.

Bibliography

1. Almada, F., Fernando, C., & Vicente, A. (2020). Infimum Times: Dimensions, Scales and Implications. *Journal of Physical Fitness, Medicine & Treatment in Sports*, 8(1).