

Study and comparison of physiological response with Harmony® suspension system and suspension with pin

Ana Rita Santos¹, Diana Fernandes¹, Joana Granadas¹, Mara Aguiar¹, Margarida Marçal¹.

¹ - Licenciature in Prosthetic and Orthotic in Lisbon Superior School of Health Technology.

Collaborations:

José Pedro Matos², Teresa Tomás³.

² -

³ -

The purpose of this study is a cross-qualitative and quantitative gait analysis in 3 traumatic unilateral amputees using prosthesis with pin suspension compared to the use of prosthesis with a high vacuum suspension, the Harmony® system.

1. Introduction

In Portugal, there aren't many studies made in the field of orthotic and prosthetic and knowledge about the number of amputees in the country. The only know is that the major cause of lower limb amputation is diabetes mellitus, being the most affected population the older age groups^{1,2}. The combination of technological developments with daily needs of the amputees is becoming more and more important for they better quality of life.

This work was done during the curricular unit "Investigation in Prosthetics and Orthotics" class, in the 4th year of Health Technology School of Lisbon, in Portugal.

This study analyzes if the change of suspension in transtibial prosthesis will influence some physiological response in amputees.

4. Tables

HR (bpm)	53,64 m/min	67,05 m/min	80,46 m/min	93,87 m/min	107,3 m/min
A - 1 st Prosthesis	111	118	118	135	
A - 2 nd Prosthesis	100	111	114	136	
B - 1 st Prosthesis	116	122	133		
B - 2 nd Prosthesis	109	116	121	137	
C - 1 st Prosthesis	142	152			
C - 2 nd Prosthesis	123	135	151		

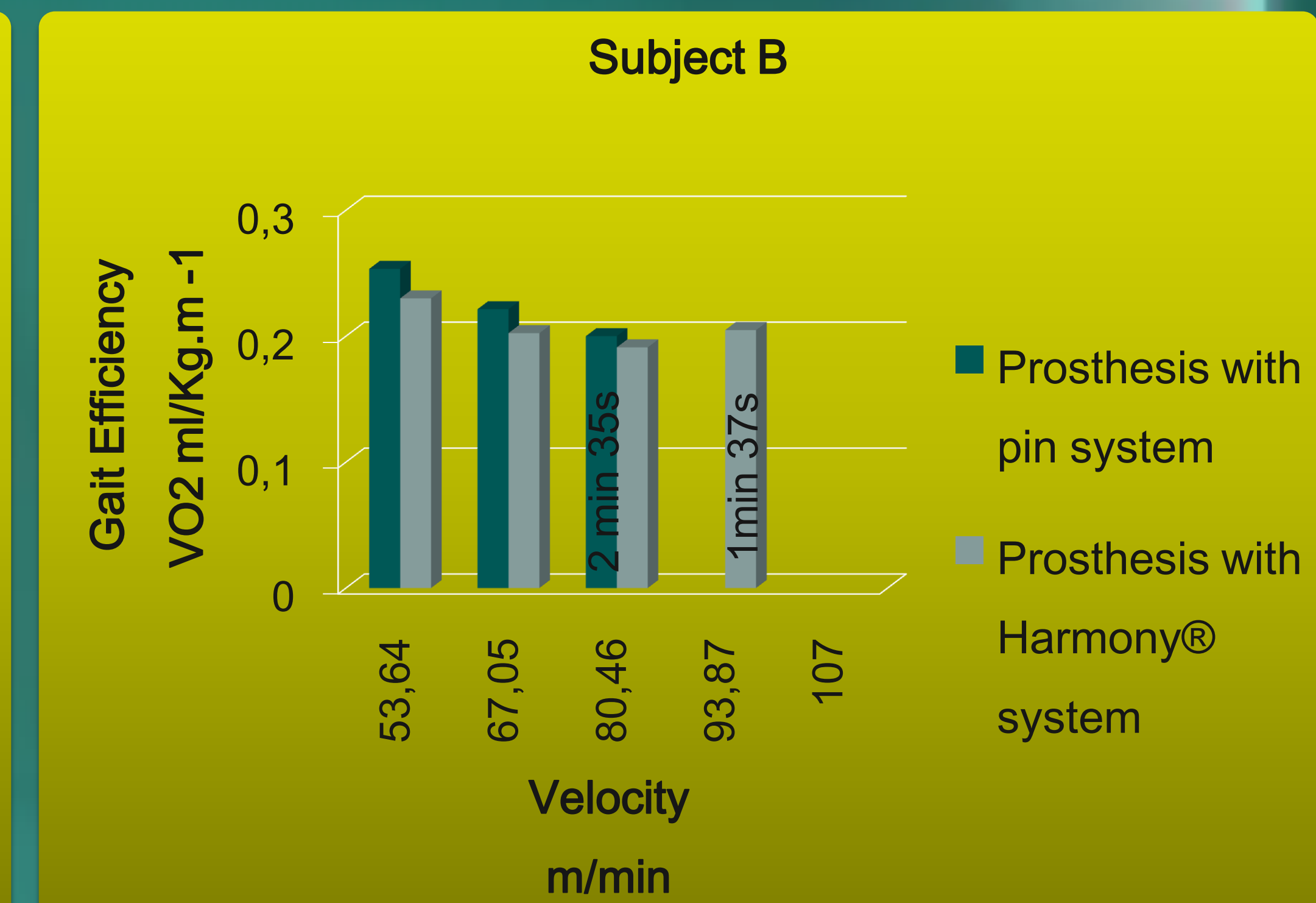
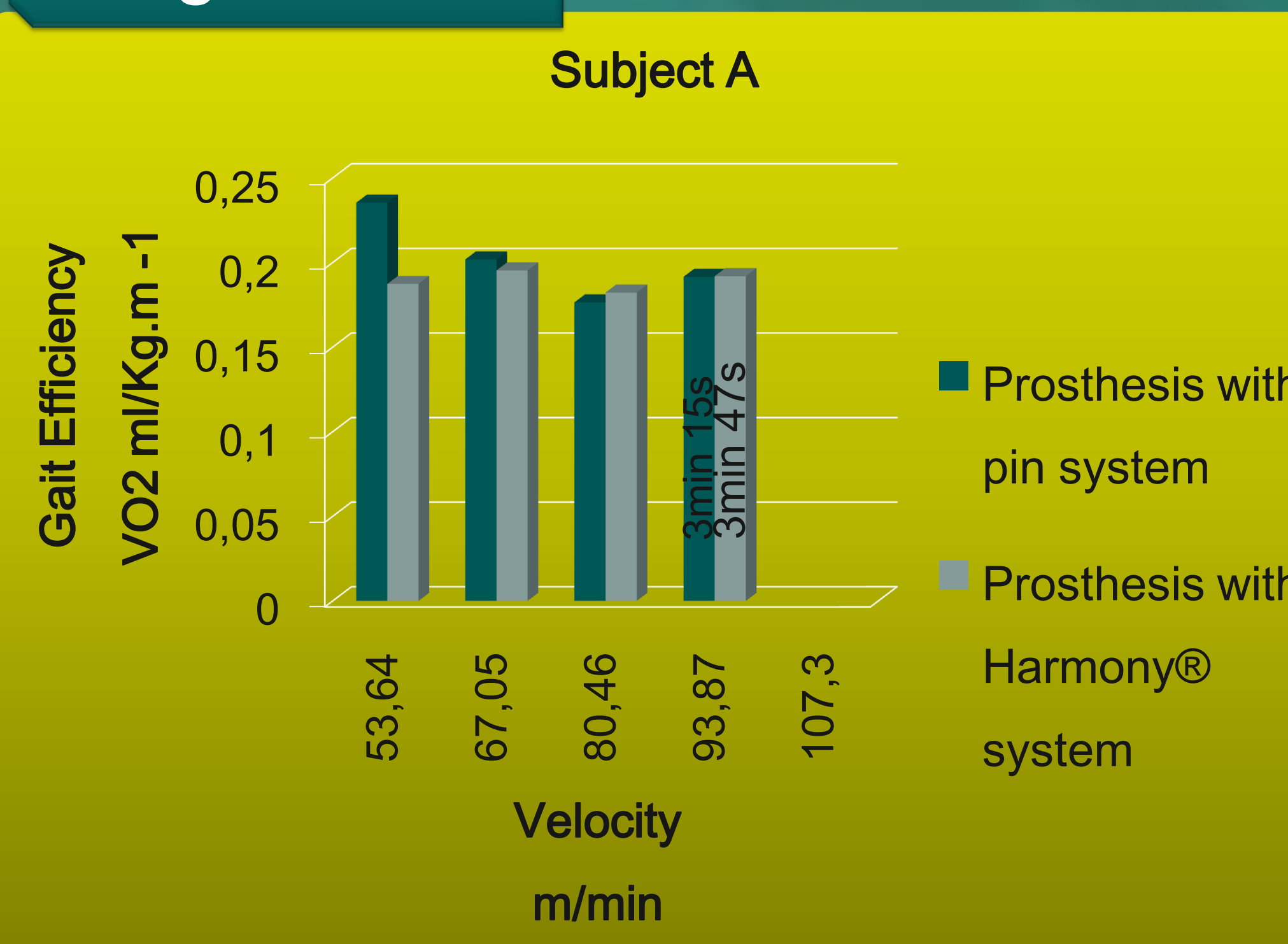
MET (Kcal)	53,64 m/min	67,05 m/min	80,46 m/min	93,87 m/min	107,3 m/min	PSE
A - 1 st Prosthesis	3,61	3,87	4,05	5,14		15
A - 2 nd Prosthesis	2,87	3,74	4,19	5,15		14
B - 1 st Prosthesis	3,88	4,24	4,59			18
B - 2 nd Prosthesis	3,53	3,88	4,39	5,49		18
C - 1 st Prosthesis	4,13	4,56				19
C - 2 nd Prosthesis	3,71	4,24	4,99			17

2. Methods

Three male unilateral traumatic amputees with transtibial amputation participated in this study. Multiple speed treadmill walking tests (53.64, 67.05, 80.46, 93.87 and 107.28 m/min) were evaluated under two conditions, the first test with a prosthetics with pin suspension system and the second with Harmony® system. The gait efficiency was calculated through the measurement of O₂ consumption (ml/kg/min) of the last minute of each 4-min session. The gait efficiency was calculated through:

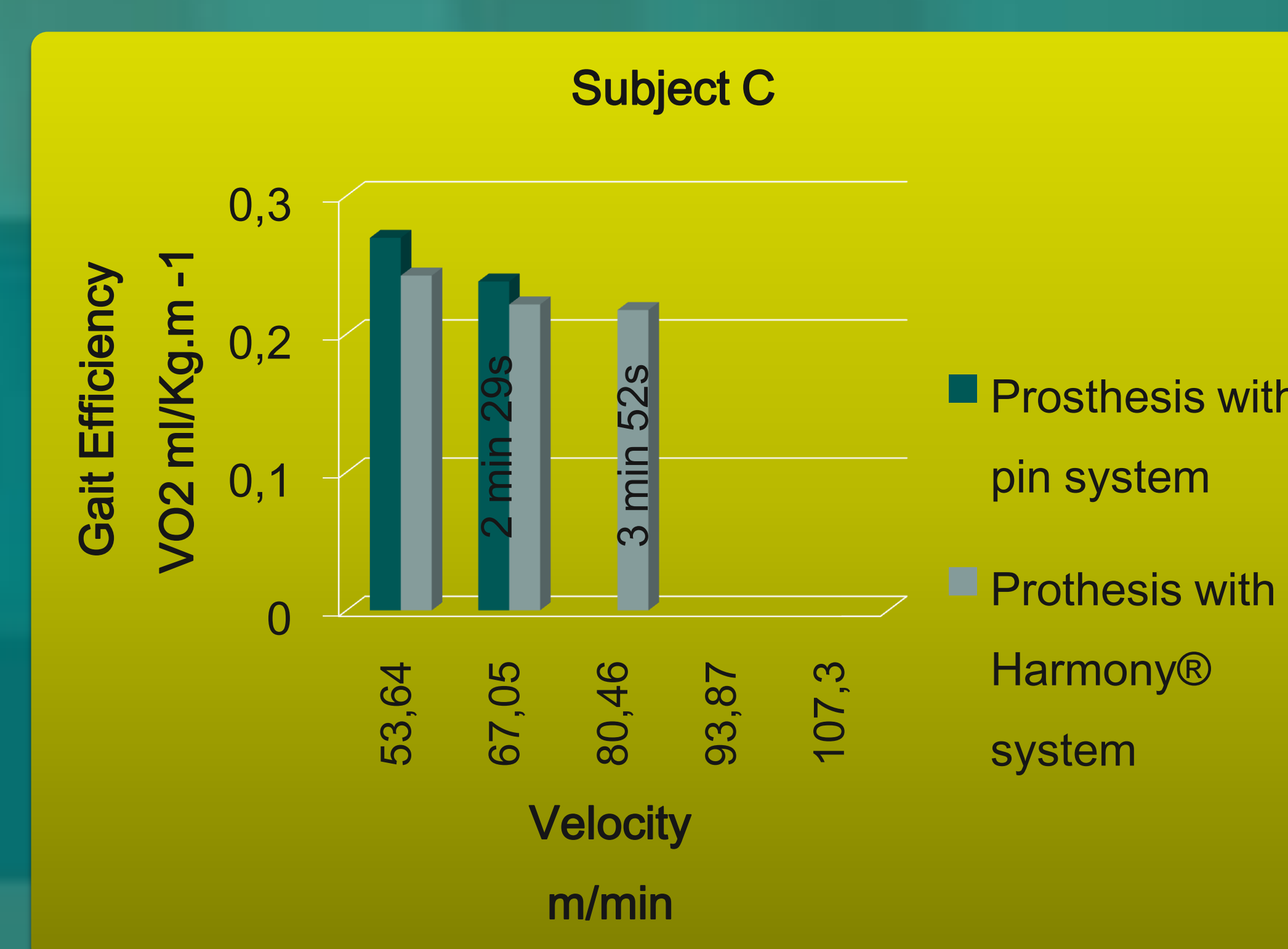
$$\frac{\text{VO}_2 \text{ ml/Kg.min}}{\text{m/min}} = \text{Gait efficiency ml/kg.m}^{-1}$$

5. Figures



3. Results

In two of the individuals (B and C), we identified a decrease in O₂ consumption, witch means an increase in the gait efficiency in second prosthesis. In the individual A, the consumption of O₂ was lower in the first two stages with the Harmony® system and in the last two with the pin system. In relation to the intensity of effort, the individual A has obtained a greater metabolic consumption in the second prosthesis, although this is not significant, relative at the first prosthesis. In the individual B and C was found a significant decrease in metabolic consumption in the second prosthesis, reflecting a lower level of effort.



6. Conclusion

The study of the physiological response of users and the use of prosthetic devices should be common practice, since it allows the technician to infer about the components used to optimize quality of life. On a way of criticism, the study can be noted that the sample size variability and gender of the participants could have been more embracing in order to infer more conclusive results. Another factor to be mentioned is that the increase in the second period of adaptation to the prosthesis could modify the results, can or cannot make a significant difference between the systems. We conclude that the system of high vacuum, Harmony® allows for a greater efficiency of movement in relation to the pin system, it also produces greater confidence and satisfaction for the users. In future studies we suggest the inclusion of vascular amputees in the sample in order to purchase the existence or not of vascular benefits levels, Harmony® system compared with different types of suspension and the testing in open spaces in order to better reproduce the reality.

7. References

- Marques, E. *et al.* (1994). Consulta de Amputados – H.S.A.C. – Estudo retrospectivo de quatro anos. Arquivos de Fisiatria, 1,143-148.
- Leão, L. *et al.* (1995). Caracterização dos amputados da consulta externa do serviço de Medicina Física e Reabilitação dos HUC. Medicina Física e Reabilitação. Coimbra, 3-5
- Berke, G. M. (2002). Transtibial Protheses. In M. Lusardi & C. C. Nielsen, Orthotics and Prosthetics in Rehabilitation (pp. 680 and 681). St. Louis Elsevier.
- Beil, T. L., Street, G. M. (2004). Comparison of interface pressures with pin and suction suspension systems, JRRD, Volume 41, Number 6A.
- Waters, R. L. (2005). Gasto Energético. In J. Perry, *Análise de marcha*, Volume 3, pp. 85-120, Manole.
- Lin-Chan, S., Nielsen, D., Shurr, D., Saltzman, C. (2003). Physiological responses to multiple speed treadmill walking for Syme vs. transtibial amputation – a case report. Disability and Rehabilitation, Vol. 25, no 23, 1333-1338.
- Nielsen, D., Shurr, D., Golden, J., Meier, K. (1988) Comparison of energy cost and efficiency during ambulation in below-knee amputees using different prosthetic feet – a preliminary report. JPO. Vol. 1, Number 1, pp. 24-31.
- Powers, S. K., Howley (2000), E.T. Fisiologia do exercício. 3ª ed., São Paulo, Manole.
- Traballesi, M., Porcacchia, P., Aversa, T., Brunelli, S., (2008). Energy cost of walking in subjects with lower limb amputations: A comparison study between floor and treadmill test. Gait & Posture 27.