

# Augmented Reality and Duplex Ultrasound in Medical Treatment Decision: Score 9-1

Kasuo Miyake\*, John Robert Pires - Davidson

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In 2005, our group have performed the first-ever use of augmented reality (AR) in medical diagnosis and medical treatment of varicose veins. AR has been used in leg vein treatment to search feeder veins bellow resilient telangiectasias. AR in combination with duplex ultrasound (DU) to evaluate refluxing saphenous veins, improved diagnostic accuracy and identified two situations where semiotics was incapable to detect or misleading: the presence of invisible feeder veins under telangiectasias and asymptomatic saphenous reflux under varicose veins. This ambiguity implied the need for a diagnostic decision tree before starting varicose vein treatment. A 9-cell table was conceived to comprehend such a decision tree comprising 2 main questions:

Question 1- on the horizontal rows: what are the types of varicose veins (with or without reflux on saphenous veins and/or perforant veins), if any?

Question 2- on the vertical columns: which kind of telangiectasias does the patient have (with or without feeder veins connected), if any?

A thorough DU evaluation answers question 1 and determines if there is axial reflux or not. AR answers question 2 determining if there are feeder veins or not. This proposed classification is intended to guide leg vein treatment and is not intended to replace any other scores, such as the Comprehensive Classification System for Chronic Venous Disorders (CEAP) or the Venous Clinical Severity Score (VCSS). This is a simple classification system that can be used for medical decision, health economics outcomes research and for outcome evaluation following aesthetic vein treatment.

**Keywords:**Augmented reality; Clacs; Duplex ultrasound; Telangiectasias; Treatment; Feeder veins; Classifications; Varicose veins

## INTRODUCTION

Augmented reality (AR) relies on a technology that superimposes a computer-generated image on a user's view of the real world, providing a composite view live direct or indirect view of a physical, real-world environment

In 2004, a medical device that could "see veins" and guide phlebotomies on arms for intravenous access was hailed by the Time Magazine as one of the best inventions of the year.

It gave both the physician and patient the ability to view the veins that were previously invisible to the naked eye (Figure 1). Interestingly, it caused skepticism to physicians but attracted significant attention to patients.

In a nutshell, infrared light was projected onto the skin, and an infrared camera captured this continuous loop of video that was processed by a computer and projected back to the skin in real-time within a fraction of a second. The final image seen was a superimposition of all superficial veins beneath the skin [1].

Since 2005, AR has been used by our group to support leg vein treatment to search feeder veins bellow resilient telangiectasias [2-4]. AR in combination with duplex ultrasound (DU) to evaluate refluxing saphenous veins allowed improved diagnostic accuracy and demonstrated two situations in which semiotics was blind or misleading: the presence of invisible feeder veins under telangiectasias and asymptomatic saphenous reflux under varicosities.

This ambiguity stressed the need for a decision tree before starting varicose vein treatments.

A table was conceived to comprehend such a decision tree.

## METHOD

A 9-cell table was devised and fashioned in 3 rows x 3 columns, implying the following 2 main questions:

Question 1- on the horizontal rows: which kind of varicose veins does the patient have (with or without reflux on saphenous veins and/or perforant veins), if any?

Question 2- on the vertical columns: which kind of telangiectasias does the patient have (with or without feeder veins connected), if any? (Table 1)



**Figure 1)** AR projecting onto the skin the image of an invisible to naked eye feeder vein(Low resolution)

Miyake Clinic, Hiroshi Miyake Research Center, São Paulo, SP, Brazil

\*Correspondence: Kasuo Miyake, Miyake Clinic, Hiroshi Miyake Research Center, São Paulo, SP, Brazil, Tel: 04542-000; E-mail: kasuo@miyake.com.br

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	No telangiectasias	Telangiectasias	Feeder veins and telangiectasias
No varicosities	1	2	3
Varicose veins	4	5	6
Saphenous/perforant Reflux	7	8	9

Score 9-1: Cells were numbered from 1 to 9 as to label 9 the highest clinical severity and to label 1 the normalcy. DU answers question 1 and thus determines if the lesion is on the first or second line. AR answers question 2 and thus determines if the lesion is on the left roll or central role.

This score has been used in our clinic since its concept and is currently undergoing prospective validation.

### DISCUSSION

This proposed score is intended to guide leg vein treatment and is not to substitute any other vein classification such as the Comprehensive Classification System for Chronic Venous Disorders (CEAP) [5] or the Venous Clinical Severity Score (VCSS)[6]. Due to costs and delay caused by regulatory agencies, AR as a diagnostic tool for varicose vein treatment is still a novelty. Many physicians worldwide also focus on the functional treatment reimbursed by the government and insurance companies. However, AR is becoming more affordable and in our opinion all studies regarding treatment of telangiectasias need to be prospectively repeated using AR as inclusion/exclusion criteria. Feeder veins presence is a rarely or never considered bias on telangiectasia aesthetical treatment outcomes.

The Score 9-1 is also known as “Miyake Classification” (MC). We propose that the MC can also be used in health economics outcomes research guidance. In phlebology, up to now, there is no clear delimitation of what should be covered by the insurance and what should be paid by the patient - aesthetic treatment. The scores 9, 8, 7 have reflux from the saphenous veins and if there are symptoms, the treatment should be provided by the government or insurance company. On the other side, scores 6, 5, 4, 3, 2 should be considered aesthetic treatment, therefore paid by the patient. This could help decrease the costs with vein treatment for the government and insurances.

In medical research, MC will also improve objectivity. Physicians from all over the world have traditionally focused on the functional treatments of venous insufficiency and varicose veins. Objective scoring systems and questionnaires have been designed to assess the clinical impact of varicose veins. Unfortunately, none of these addresses the impact of telangiectasia and its treatment despite of clinical prominence. MC is a unique tool that may overcome this dilemma. It not only objectively characterizes the patients accordingly, but it's also a tool that can track progress or improvement as one moves from a higher to lower number via superficial venous interventions.

After each treatment, the patient is re-evaluated and re-scored. MC may be a useful outcome assessment instrument in current and future clinical trials.

Amongst the various medical disciplines, phlebology is one of many that benefited from its use.

Diagnostic accuracy was vastly improved, especially in the presence of invisible feeder veins under telangiectasias, which had been associated with recurrence of spider veins/telangiectasia post-intervention.

These feeder veins, due to its superficial location, were often missed on venous duplex ultrasonography. AR is currently being used worldwide not only to find feeder veins but also to guide treatments such as in CLaCS (Cryo-Laser and Cryo-Sclerotherapy) [7,8].

### CONCLUSION

This is a simple classification system that can be used in health economics outcomes research and for outcome evaluation following vein treatment. Further validation is needed, and this new scoring system may be used in future clinical trials on aesthetic phlebology.

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