

# EXPERT REPORT

**YouDome anthropometric monitoring  
system®**



# Key points

---

## Context

- There is not currently a simple method that can be set up at the training centre to evaluate the anthropometrics of the club's players (circumference & volumes of the arms, legs and trunk). However these measurements prove very useful for monitoring players having muscle strengthening and weight loss objectives, as well as in the contexts of stopping or resuming training (inter-season & injuries).
- This type of measurement would also allow better monitoring of Academy players' physical development.
- During the 2015-16 season, 49 players were tested and nearly 150 tests were done.

## Positive points

- The measurements made by YouDome are accurate (to about 1.2%) and reproducible (to about 1% for the majority of body circumferences and to about 2% for volume measurements).
- The sensitivity level of YouDome allows satisfaction in monitoring anthropometric modifications caused by stoppage periods and programmes intended to increase the muscle mass or lose fat mass.
- The YouDome allows reference measurements to be established for all the player's body regions in only 30 seconds, which was impossible until now,
- Coupled with an evaluation of the body composition the YouDome system allows the players profile to be accurately characterised.

## Points to be improved

- Better standardisation of the arm position during the measurement phases has been requested from the YouDome system designer,
- An improvement to the operating software has been requested to ease analysis of the data and comparison of the measurements over time,
- Measurements can currently only be made at the YouDome head office in Monte Carlo, which complicates access for the players and setting up the tests.

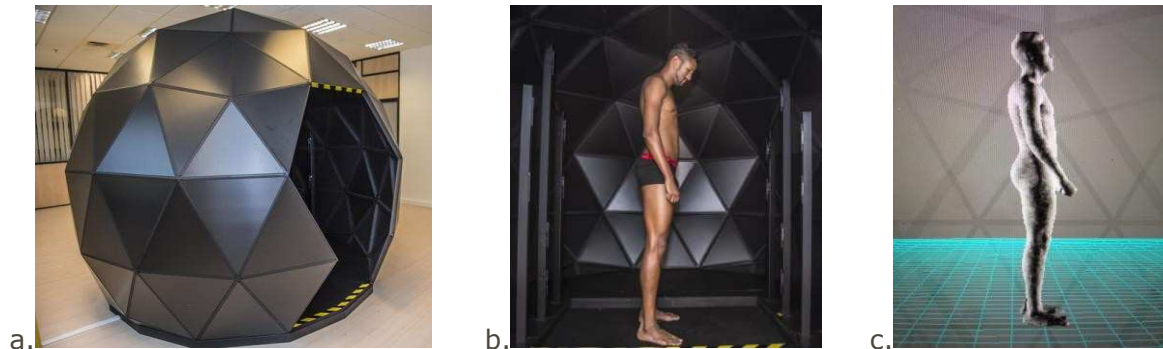
## Prospects

- The medical staff wish to be able to make anthropometric monitoring for Academy players and the professional group systematic to optimise care of injuries and assess their responses to training,
- The provision of a system at La Turbie is necessary to ease collection of their data and optimise support to the club's players,
- The YouDome company is interested in extending the partnership contract with AS Monaco FC. The partnership conditions remain to be defined.

## Context and objectives

---

The Monaco company YouDome has designed a capture system allowing the creation of a 3D avatar with a high degree of resolution. The development of this tool interests AS Monaco Football Club in so far as there is currently no simple, fast and accurate means of measurement to provide anthropometric monitoring of the club's players.



**Figure 1.** Exterior and interior views of the YouDome (a, b) and an avatar from a measurement session (c)

The technology proposed by the YouDome company allows determination of the circumference and volume of different body regions (trunk, leg, thigh, etc.). This is interesting for:

- characterising the development of anthropometrics for Academy players,
- evaluating the effects of the muscle reinforcement and weight loss programmes that are set up,
- monitoring changes in injured limbs during a period of immobilisation.

During a season, AS Monaco made tests to evaluate the benefit of this new tool for football players in training and professional players. In total, 49 players were tested and 150 evaluation sessions were completed.

## Tests done

---

The tests performed with the YouDome allowed the evaluation of:

- the reliability of the results supplied by the YouDome compared to a reference measurement method (the tape measure),
- the reproducibility of measurements by the apparatus,
- the sensitivity of the apparatus for detecting anthropometric changes induced by a period of immobilisation or a muscle reinforcement programme.

## Validity

---

30 reliability measurements were made to evaluate the reliability of the measurements made by the YouDome compared to the measurements made with a tape measure. These measurements were

made in round anatomic regions easing the taking of measurements with the tape measure (around arm, knee, calf and ankle).

Issue	Result	Interpretation
Correlation between the 2 measurement	> 0.95 for all the measured zones	<b>Very satisfactory</b>
Absolute bias (cm)	0 to 1.0	<b>Satisfactory</b>
Relative bias (%)	0 to 4 %	<b>Satisfactory</b>

**Table 1.** Results obtained during validity tests for YouDome compared to the tape measure

The results obtained have shown an accuracy level that is entirely satisfactory for all the measurements made.

## Reproducibility

6 players were evaluated 3 times consecutively during the same evaluation session to determine the measurement standard deviation for each anatomic region. This represents the margin of error within which each YouDome measurement of a test is located relative to another. The lower it is the more this indicates that the variations observed between two evaluations for the same player reflect reality and not a measurement error.

Parameters	Standard deviation	Interpretation
Size	0.3 ± 0.3%	<b>Very satisfactory</b>
Chest circumference	0.5 ± 0.3%	<b>Very satisfactory</b>
Waist circumference	1.0 ± 0.9%	<b>Very satisfactory</b>
Abdomen circumference	1.0 ± 1.0%	<b>Very satisfactory</b>
Torso volume	1.4 ± 1.0%	<b>Very satisfactory</b>
Hip circumference	0.4 ± 0.2%	<b>Very satisfactory</b>
Left thigh circumference	1.6 ± 1.2%	<b>Very satisfactory</b>
Right thigh circumference	1.0 ± 0.7%	<b>Very satisfactory</b>
Left knee circumference	0.5 ± 0.3%	<b>Very satisfactory</b>
Right knee circumference	0.7 ± 0.8%	<b>Very satisfactory</b>
Left calf circumference	0.4 ± 0.3%	<b>Very satisfactory</b>
Right calf circumference	0.4 ± 0.4%	<b>Very satisfactory</b>
Left ankle circumference	0.9 ± 0.9%	<b>Very satisfactory</b>
Right ankle circumference	1.0 ± 0.9%	<b>Very satisfactory</b>
Volume of left lower limb	1.1 ± 0.6%	<b>Very satisfactory</b>
Volume of right lower limb	0.8 ± 0.3%	<b>Very satisfactory</b>
Left arm circumference	1.2 ± 1.1%	<b>Very satisfactory</b>
Right arm circumference	1.8 ± 1.2%	<b>Very satisfactory</b>
Volume of left upper limb	4.9 ± 3.2%	<b>To be improved</b>
Volume of right upper limb	4.2 ± 3.3%	<b>To be improved</b>

**Table 2.** Results obtained during YouDome measurement reproducibility tests

The reproducibility tests have revealed very satisfactory results for all the circumferences and volumes determined on the trunk and lower limbs. This point is particularly positive in so far as it related to the regions of the human body that are most important to evaluate for football players. For the upper limbs the results are satisfactory where the circumferences are concerned but not for the volumes.

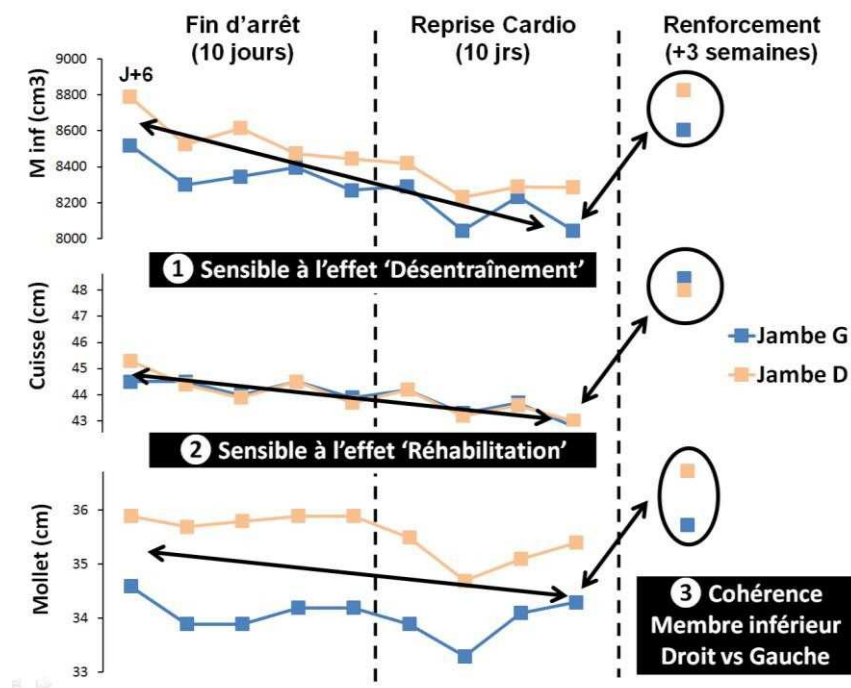
After analysis and discussions with Xavier Boquet, the designer of the YouDome, it appears that this error is related to poor standardisation of the position of the arms during the tests. In consequence, Xavier Boquet will develop a system of handles that will allow this problem to be solved.

## Sensitivity - Case studies

The sensitivity of measurements by the YouDome system has been determined from several case studies. These tests have allowed the potential usefulness of the anthropometric tests to be tested in real contexts that concern the club. Two clinical cases are described below:

### ① Monitoring an injured player (training stopped and resumed)

The first case below shows the change in the volume of the lower members and thigh and calf circumferences in an Academy player with a hamstring injury (Figure 2). The first measurement was made 6 days after the injury. The data presented have thus been collected during the stoppage phase and after 3 weeks resumed training.



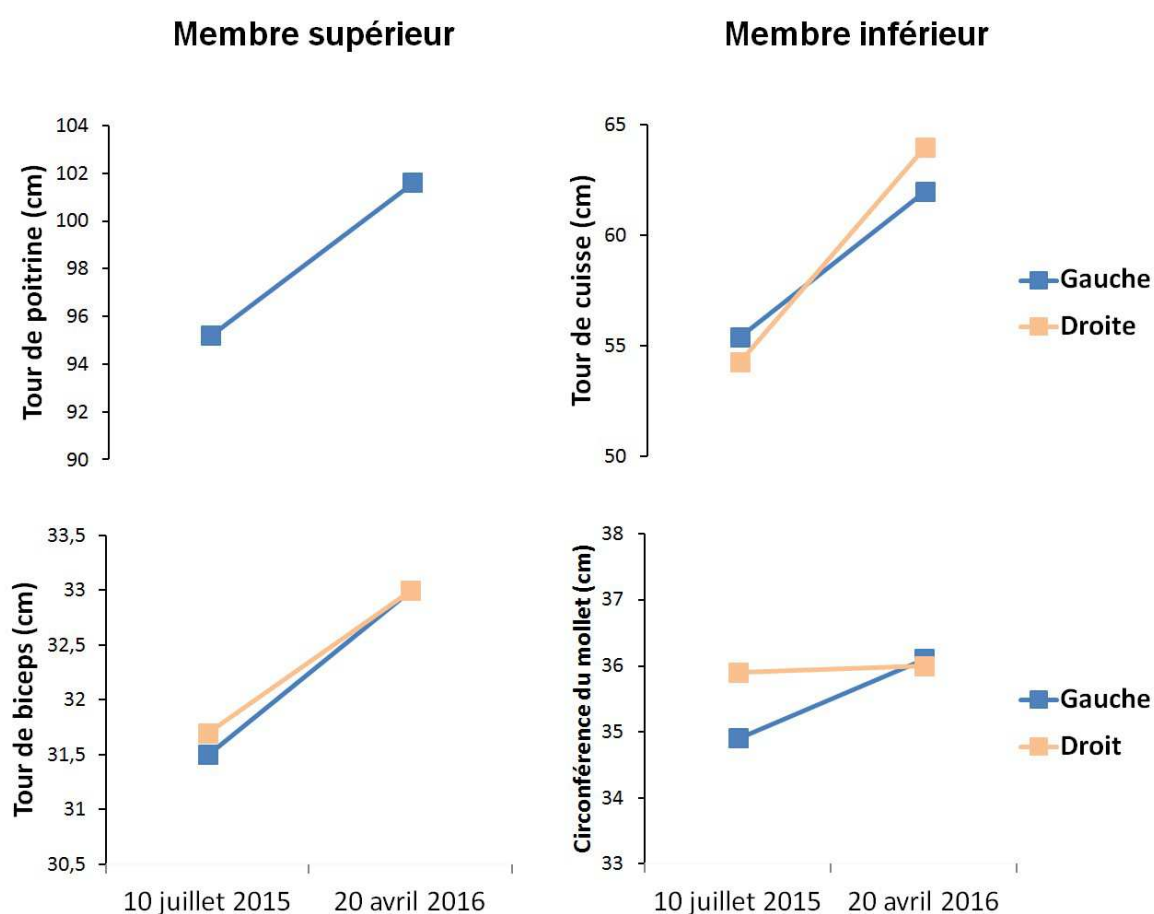
**Figure 2.** Anthropometric monitoring done with the YouDome for a player with a hamstring injury

The results show that the measurements collected with the YouDome system are sensitive to the anthropometric consequences induced by:

- lack of training (the reductions are notable),
- the retraining phase (for example it can be confirmed here that the player returns to the initial values after the rehabilitation phase),
- asymmetries (it is noted that the differences between the left and right legs are consistent over time).

## ② Monitoring of a player during a muscle reinforcement programme

The second case concerns a professional player subject to a muscle reinforcement programme during several months of this season (Figure 3). The first measurement was done in the 2015-16 interseason and the second in the month of April 2016.

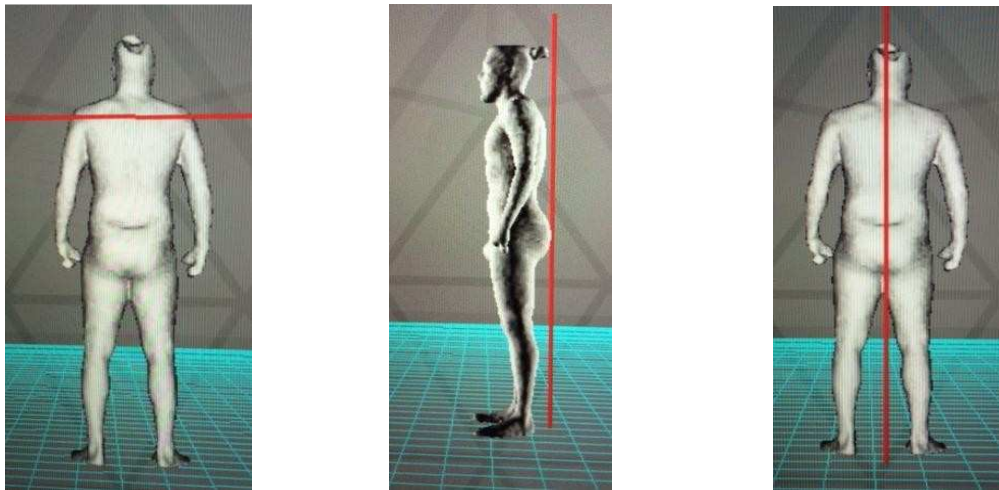


**Figure 3.** Anthropometric monitoring of a professional player involved in a muscle reinforcement programme over several months

## Posture analysis

---

The avatar produced by the YouDome allows 3D posture analysis, which can be found interesting to ease the detection of posture imbalances.



**Figure 4.** Posture analysis permitted by the YouDome

## Prospects

---

The tests performed with the YouDome are conclusive. The data obtained are accurate, reproducible and sensitive to the morphological variations that the medical staff wish to be able to evaluate in Academy players and the professional group. Also, the YouDome allows accurate measurements to be obtained over the whole body in only 30 seconds, which is impossible to do with a tape measure.

At this stage the medical staff of AS Monaco FC envisage using the YouDome during the 2016-17 season to:

- Put in place longitudinal monitoring during a complete sporting season over all the club's players,
- Make it a check on achieving the physical preparation and nutritional support objectives (muscle mass gain, fat mass loss),
- Monitor the development of the anthropometric parameters during stoppage phases caused by injuries and understand better the responses observed depending on the types of injuries and their seriousness,
- Determine if this is a relevant criterion to use for resumption after injury.

The provision of a system at La Turbie is necessary to ease collection of their data and optimise support to the club's players. The YouDome company is interested in extending the partnership contract with AS Monaco FC. The partnership conditions remain to be defined.