Breast tonometry – a practical device for accurate measurement of capsule-formation

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Summary. The development of an indentation tonometer is described as an objective measuring device. Capsule-formation and contracture around a breast-implant after augmentation or reconstruction may be accurately measured. The possibilities and restrictions of the tonometer are evaluated. In 10 years of experience the indentation tonometer has proven its value as an objective measuring device in the follow-up of patients.

Key words: Breast tonometry – Indentation tonometer – Capsule formation

A simple device to objectively measure intramammary pressure is still needed for objective references of capsule contracture after breast augmentation and reconstruction. After several prototypes, a type of tonometer was developed which has been in use since 1979 in our clinics. In the same period Moor [6] applied a similar principle based on Goldman's applanation tonometry to estimate ocular pressure. A table to express the area of contact (diameter in cm) in cm H₂O was needed. Measurements were taken with the patient in a supine position. Hayes [5] applied indentation tonometry of breasts and used fixed and variable depth probes taking four readings with each probe, but with the patient sitting up. Objective measurements were consistently reproducible.

An instrument for the evaluation of tissue tonicity was reported by Clodius et al. [3]. He described a modified tonometer as used in ophthalmology to test the resistance of the tissues (tissue compressibility) for the evaluation of lymphoedema. In 1976 he also reported using the same instrument as a mammatonometer incidentally [4].

If a breast tonometer wants to have any chance of being universally applicable, it must answer the following criteria: (1) reliability, (2) simplicity, (3) ease in handling, (4) strong enough to be carried in a doctor's pocket and (5) sterilisable.

This paper aims to present a simple and reliable device which answers those demands and has proven its value in the past ten years.

The tonometer

The tonometer consists of an acrylic casing of 7.5 cm long; at one end the casing has a base plate, 5 mm thick and 4 cm diameter. Through the core of the casing runs a stainless steel rod of 6.5 mm in diameter and 10.5 cm long. The rod is pushed out of the casing at the base plate for 22 mm by a stainless steel spring (Fig. 1). The other end of the rod, hidden inside the casing when not in use, has calibrated 1 mm engravings, wider at every centimeter.

Computing the shortening of any spring relative to the pressure applied gives a curve which shows that initially little pressure is necessary to bring about shortening; then there is a straight part of curve, and finally ever greater pressure is needed for ever less shortening (Fig. 2). The spring in the tonometer we present is so devised, that the compression possible by moving the stainless steel rod only takes place in the straight part of the spring's compression curve.

Measuring intramammary tension

The tonometer has now been successfully used in assessing breast tension for many years in hundreds of cases. The patient stands or sits upright with the arms resting downwards to decrease the muscle tension of the pectoralis major. The tip of the rod sticking out of the base plate of the tonometer is put perpendicularly on the skin.

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¹ Orders for (prototypes of) the tonometer may be addressed to the senior author.
The tonometer casing is pressed down until the base plate touches skin all around the rod. The rod thereby indents the skin and breast tissue and at the same time emerges at the other end of the casing. The number of engraved stripes on the emerging rod is read and represents the tension of the indented tissue (Fig. 3). This can be expressed in grams/cm². After a little experience, measuring only takes a few seconds. The tonometer should not be used with the patient in a recumbent position because there is less uniformity in the form of the breast and also the implant may slip laterally [2].

**Placement of the tonometer**

Tension in the majority of female breasts can be easily measured on the medial side. In some cases, however, there is so little breast tissue in this area, that only the thoracic wall tension is measured. The tonometer may then have to be placed laterally on the breast. Placing the tonometer vertically on the lower pole of the breast makes readings uncertain, because not only intramammary tension but also the weight of the breast is measured.

**Restrictions of measurements**

Any measurement taken depends on the following variables:
1. the elasticity of the skin
2. the position of the individual to be tested
3. the consistency of the subcutaneous tissue
4. the breast tissue itself
5. the quality of the implant and its surrounding capsule
6. the underlying musculature.

With every subject any of the variables is different. The measure found is only the total sum of these variables. Capsule formation does have its influence on the total sum but this will be different in every subject tested. Each measure found is related to a specific subject in those given circumstances, readings at different times are of a value relative to each subject. However, the measurements found for different subjects are in the same range. A subjective change of capsule formation around a breast implant can always be verified by a different measure which is then found.

When a mammary implant is placed behind the muscle, capsule formation can also be verified when the muscle is relaxed; the average readings will be slightly higher.

**Clinical examples**

Measurements are usually taken 6 weeks post-operatively, 3 months, 6 months and 1 year. These measurements may be expressed in a graph (Fig. 4, 5).