

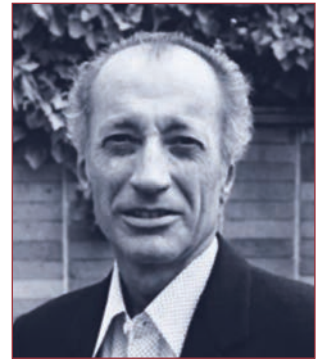
JOAQUIM BARRAQUER I MONER

BARRAQUER CATARACT EXTRACTION TECHNIQUE

The eponym

Barraquer technique or enzymatic zonulolysis.

A cataract extraction technique using α -chymotrypsin. Zonulolysis consists of luxating the zonule of Zinn using locally instilled α -chymotrypsin. It is a method conceived by Joaquim Barraquer to aid surgical extraction of cataracts¹.



Joaquim Barraquer
i Moner (1927-2016)

Joaquim Barraquer i Moner (1927-2016)

Joaquim Barraquer i Moner was born in Barcelona on 26 January 1927. He was the son of Ignasi Barraquer i Barraquer³ and Josefa Moner i Raguer; like his brother Josep Ignasi⁴, Joaquim studied medicine at the *Universitat de Barcelona*, graduating in 1951. A few years later (1955), he defended his doctoral thesis *Potencialización farmacodinámica en oftalmología* (Pharmacodynamic potentialisation in ophthalmology)² at the *Universidad de Madrid*⁵. From a very young age he was interested in the natural sciences, biology, and mechanics. Despite a keen interest in engineering, coming from an important family of ophthalmologists, he chose ophthalmology early on.

While just 13 years old and still in secondary school, he helped his father in cataract operations. As he explained: "I began to watch my father's work at 11 years old. He spent many hours attending patients, working in the laboratory, studying medical histories, and doing surgery. In fact, I recall my father operating on a cataract when I was 13, and I was watching and helping him"⁶. During his studies at the faculty he continued to train alongside his father, and when he graduated he joined the *Centre d'Oftalmologia Barraquer* permanently, where from the start he combined visiting patients with research and teaching^{6,7}. Two years after graduating, he was already running specialised ophthalmology courses for postgraduates at the *Institut Barraquer* while working as chief surgeon at *Clínica Barraquer*. Four years after that, he was named vice-president of the *Institut Barraquer* and in 1961 he became the centre's executive director⁸. He founded the *Banc d'Ulls de Barcelona* (the first eye bank in Europe) and was its director. When his father died, it was he who removed his corneas, transplanting them the same day; likewise, years later when his mother died, he was the one who transplanted her corneas.



Joaquim Barraquer
i Moner at the age of
13 with his father,
Ignasi Barraquer
i Barraquer⁶

He and his wife, Mariana Compte, whom he had met in 1952, had three children, two of whom, Elena (1954) and Rafael Ignasi (1956), continued the family's ophthalmologist tradition.

His teaching activity was always intense, both as an adjunct to his research and consulting and at university, where he was professor of ocular surgery at the *Universitat Autònoma de Barcelona* and director of the *Escola Professional d'Especialització Oftalmològica* at the *Institut Barraquer*, ascribed to the same university.

His best-known contribution in the field of ophthalmology was enzymatic zonulolysis, a technique that bears his name. He was a pioneer in the inclusion of intraocular lenses, having also designed some. In 1964, along with his brother, Josep Ignasi, he developed a special microscope for microsurgery using a slit microscope that allows biomicroscopy and a view of an "optical cut" of the transparent areas of the eye. In 1965, in collaboration with the optical engineer Hans Littmann, he invented another special microscope for filming microsurgery procedures.

Furthermore, he designed numerous instruments and developed diverse original operating techniques for treating different ocular symptoms⁶. Examples of the instruments he designed are a keratoprosthesis model, an anterior chamber lens model, anterior chamber lens pincers, an eyelid separator-aspirator, a multi-perforated cannula for aspirating vitreous humour, and a pincer for extracting sutures. Examples of the techniques he devised include peripheral iridectomy in penetrating keratoplasty to avoid pupillary block, and the simultaneous operation consisting of keratoplasty, trabeculectomy, cataract extract, inclusion of the lens in the posterior chamber, vitrectomy, and reconstruction of the iris diaphragm⁵.

He published many books and about 400 scientific articles; he also made over 100 films on surgical or experimental techniques (the earliest in 1953), some of which won prizes at scientific film festivals.

His professional and personal prestige were recognised through numerous prizes and awards, including the Josep Trueta Medal for Health Merit (2000), awarded by the *Generalitat de Catalunya* (Government of Catalonia), and the Gold Medal accrediting him as "Ophthalmologist of the Millennium", awarded by the International Academy for Advances in Ophthalmology at the III International Conference on Advances in Ophthalmology in Mumbai (India), also in 2000.

Joaquim Barraquer died in Barcelona on 26 August 2016.

Barraquer cataract extraction technique: enzymatic zonulolysis

In 1957, Joaquim Barraquer discovered the action of α -chymotrypsin on the zonule and developed the technique known as “enzymatic zonulolysis” or “Barraquer technique”. This discovery was the result of extensive research that, as he explained, to a certain extent continued a line of research begun by his father³:

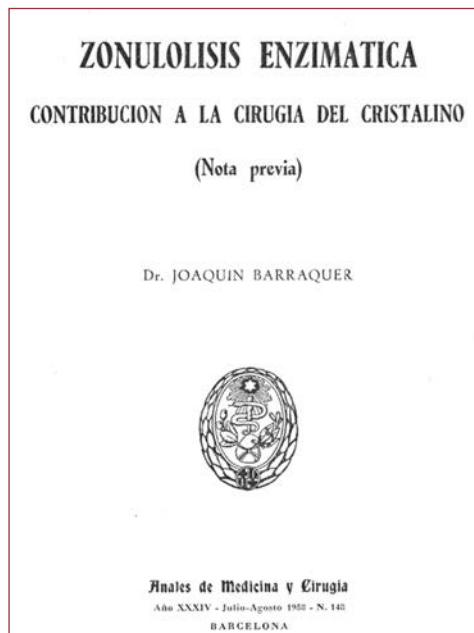
“You ask me whether I managed to finish any of my father’s research that he was unable to complete? –I recall that in the conversations we had, he would often toss around a particular idea. He said: ‘We need to find something to soften the zonule, which is the ligament that holds the cataract within the eye, so we can extract it more easily’. In 1917, my father had invented the erysiphake that bears his name [...] but the problem persisted in young patients as that ligament was too firm and made the operation difficult. Until one day I discovered the effect of a digestive enzyme, α -chymotrypsin, that, when injected during the operation into the eyeball’s posterior chamber about two minutes before the extraction, produces a lysis of the zonule, enabling effortless extraction. I was thereby able to put one of my father’s wishes into practice”⁷.



From left to right,
Joaquim Barraquer i Moner,
his father Ignasi Barraquer
i Barraquer, and his older brother
Josep Ignasi Barraquer i Moner.
Barcelona, c. 1963

Joaquim Barraquer presented the early results of this novel technique on 8 April 1958 at the *Reial Acadèmia de Medicina de Barcelona* in a paper entitled: *Zonulolisis enzimática. Contribución a la cirugía del cristalino (nota previa)* (Enzymatic zonulolysis: Contribution to lens surgery [preliminary note])⁹ published in *Anales de Medicina y Cirugía* the same year¹⁰. As he introduced the paper, Joaquim Barraquer explained:

“For some time our investigations have been directed towards finding a ‘chemical zonulotomy’. As often occurs in research, serendipity pointed to the solution. After we injected a 1/500 α -chymotrypsin solution into the vitreous chamber of a patient with massive haemorrhage in the vitreous humour that had not been reabsorbed after a year of treatment, during the first wound care a day later, we observed that the lens had luxated in the vitreous humour”.



Cover of the article reproducing the conference given by Joaquim Barraquer at the *Reial Acadèmia de Medicina de Barcelona* on 8 April 1958⁹, in which he first presented enzymatic zonulolysis

And later: "Luxation of that lens suggested that α -chymotrypsin might be the substance we had sought for years, and, with the aim of verifying that such luxation was not due to the mechanical effect of lavage, we carried out the following [...]". The experimental research on the technique was done in several stages: first on rabbits, later on enucleated human eyes from cadavers, and, lastly, *in vivo* on blind human eyes (functionally useless human eyeballs). They used different concentrations of α -chymotrypsin, from 1/1,000 to 1/30,000. The results, which enabled them to systematise a new operating technique using α -chymotrypsin 1/5,000, showed that:

"In all cases we have been able to verify during the operation, along with zonular lysis, the absolute integrity of the hyaloid membrane and the lens capsule. The course of the operation was completely normal; we observed no inflammatory reactions in the neighbouring structures or alterations in the transparent media. Our experiences lead us to believe that enzymatic zonulolysis opens a new path in lens surgery that will allow the erysiphake technique to be used in patients of all ages, supplanting extracapsular extractions [...]. Total extraction of the transparent lens in extreme myopia can be performed in patients of all ages".

This new technique, enzymatic zonulolysis, was also published in 1958 in *Acta Ophthalmologica*; last paragraph of this publication said:

"Our experience makes us believe that the enzymatic zonulolysis opens a new field in the surgery of the crystalline lens, making it possible to perform intra-capsular lens extraction at any age. Total intracapsular extraction of the transparent crystalline lens will be possible at any stage, eliminating the classical Sperino-FuLala-Vacher operation with all its inconveniences. The presumed risks of retinal detachment will diminish, since the tractions required for the mechanic rupture of the zonula are avoided"¹¹.



First page of the article on
enzymatic zonulolysis by Joaquim
Barraquer, published in *Acta
Ophthalmologica* (1958)¹¹

So this procedure hugely aided intracapsular or total extraction of the cataract (also in Barraquer's words): "We can compare the old method to the modern one as if, instead of tearing a dry stamp off an envelope, we soak it first so that, once the glue has softened, it comes unstuck smoothly and more easily"⁶.

As well as the exposition and publication of the results, that year (1958) he made different films showing this technique, including, among others, *Zonulolisis enzimática. Estudio experimental* (Enzymatic zonulolysis: experimental study) and *Zonulolisis enzimática. Acción de la alfa-quimotripsina sobre la zónula. Práctica de la intervención. (Un ojo mediante fermento, el otro por el método clásico)* (Enzymatic zonulolysis:

action of alpha-chymotrypsin on the zonule. Doing the intervention [one eye using the digestive enzyme, the other the classic method]). He presented the results at the *LXV Congrès de la Société Française d'Ophtalmologie* and at *Les Entretiens Annuels d'Ophtalmologie* in Paris, where he showed his film *Zonulolyse enzymatique*⁵ (Enzymatic zonulolysis).

News of the technique's success spread rapidly worldwide and enzymatic zonulolysis has become one of the most commonly employed techniques for total cataract extraction.

References

1. Casassas O. Diccionari Enciclopèdic de Medicina. Barcelona: Acadèmia de Ciències Mèdiques de Catalunya i de Balears, Enciclopèdia Catalana; 1990. p. 1626.
2. Barraquer Moner J. Potencialización farmacodinámica en oftalmología [doctoral thesis]. Publicaciones Monográficas del Instituto Barraquer, 3. Barcelona: Instituto Barraquer; 1954.
3. Guardiola E, Baños JE. Eponímia mèdica catalana. El mètode o operació de Barraquer: la facoèrissi. *Annals de Medicina*. 2000;83:114-6.
4. Guardiola E, Baños JE. Eponímia mèdica catalana. Les tècniques de Barraquer en queratoplàstia refractiva: la queratofàquia i la queratomileusi. *Annals de Medicina*. 2000;83:231-3.
5. Currículum vitae del Profesor Joaquín Barraquer. Barcelona, January 1986.
6. Centro de Oftalmología Barraquer. Barcelona: Centro de Oftalmología Barraquer; 1991. p. 27-37.
7. Campos DS. Joaquín Barraquer Moner. Una motivación genética. *Biograma*. 1974;1(4):178-81.
8. Aparicio O. El árbol y la ciencia de los Barraquer. *Biograma*. 1974;1(4):151-70.
9. Barraquer J. Zonulolisis enzimática. Contribución a la cirugía del cristalino (nota previa). Comunicación a la Real Academia de Medicina de Barcelona. Barcelona, 8 April 1958.

10. Barraquer J. Zonulolisis enzimática. Contribución a la cirugía del cristalino (nota previa). *Anales de Medicina y Cirugía*. 1958;34:255-66.
11. Barraquer J. Enzymatic zonulolysis. Contribution to the surgery of the crystalline lens (preliminary note). *Acta Ophthalmol*. 1958;36(5):803-6.

Further reading

Barraquer J. Enzymatic zonulolysis in lens extraction. *Arch Ophthalmol*. 1961;66:6-11.

Barraquer J. Enzymatic zonulolysis. *Proc R Soc Med*. 1959;52:973-81.

Traserra i Parareda J. Joaquim Barraquer i Moner. In memoriam. *Rev R Acad Med Catalunya*. 2017;32(1):26-7.