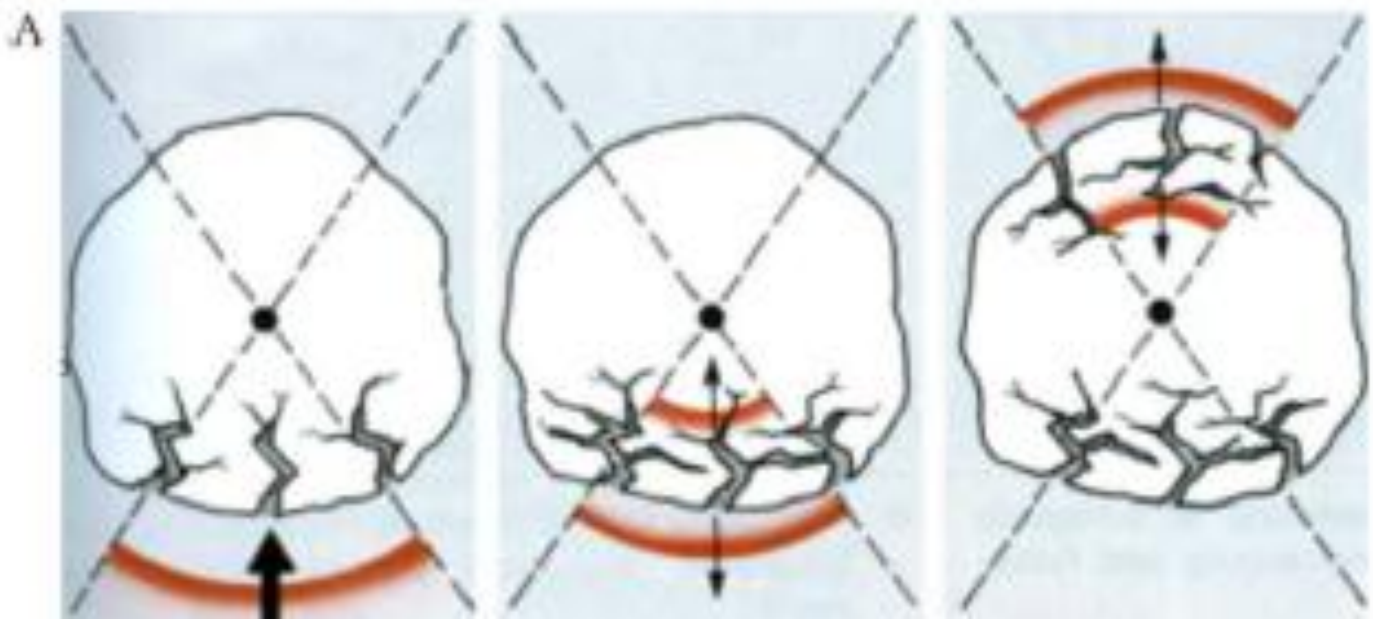
Μηχανισμοί κατακερματισμού των λίθων

- Παρόμοια με το κάταγμα σε οποιοδήποτε εύθραυστο αντικείμενο
- Δημιουργούνται μικρές ρωγμές σε σημεία στα οποία το stress των κρουστικών κυμάτων ξεπερνά ένα κριτικό όριο.
- Η συσσώρευση αυτών των ρωγμών οδηγεί στον κατακερματισμό του λίθου

Rassweiler et al Eur Urol 2011

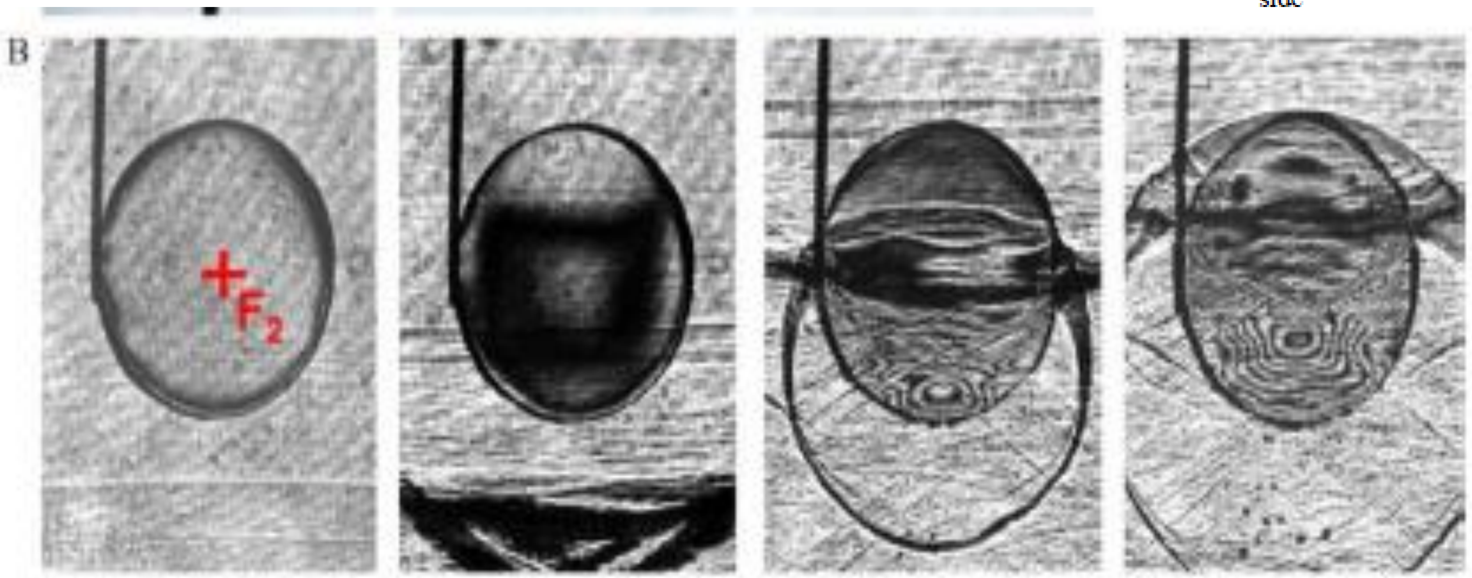
Tear and shear forces

Hypothesis	Mechanism	Prerequisites	Type of action	Comments
Tear and shear forces [1]	Pressure gradients resulting from impedance changes at the stone front and distal surface with pressure inversion	Shock wave smaller in space extension than the stone	Hammer-like action resulting in a crater-like fragmentation at both ends of the stone	Only relevant for small focus zones



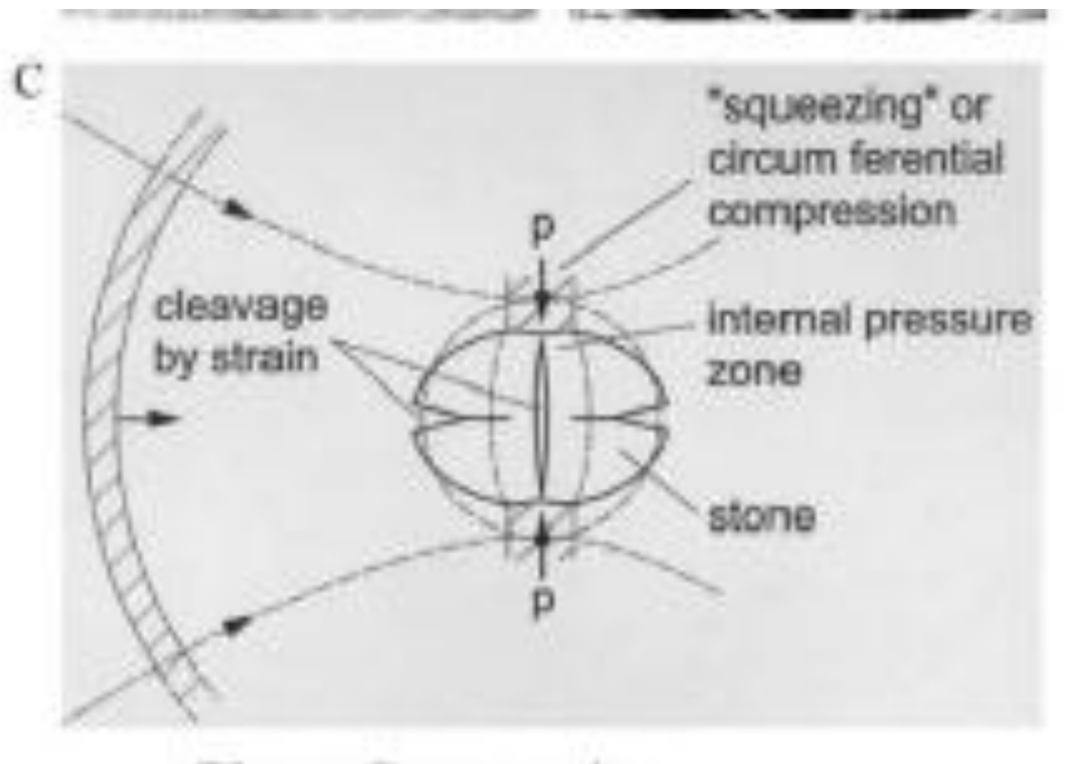
Spallation

Hypothesis	Mechanism	Prerequisites	Type of action	Comments
Spallation [9]	Reflected tensile wave at distal surface of the stone with maximum tension at the distal part of the stone	Shock wave smaller in space extension than the stone	Breaking the stone from the inside like freezing water in brittle material	Only relevant for small focus zones No explanation for stone breakage at the front side



Quasi-static squeezing

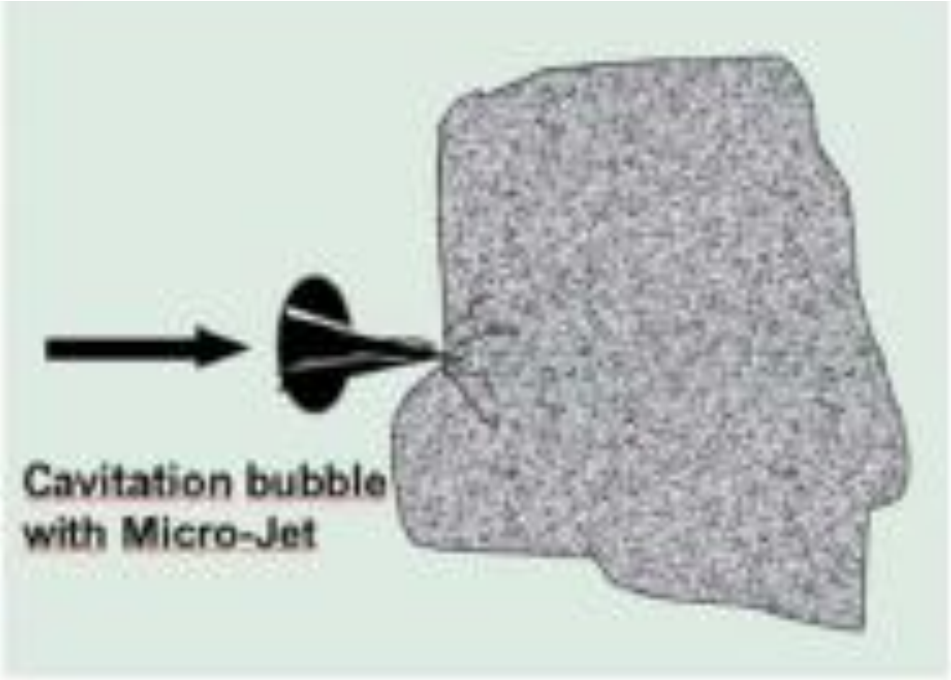
Hypothesis	Mechanism	Prerequisites	Type of action	Comments
Quasi-static squeezing [11]	Pressure gradient between circumferential and longitudinal waves results in squeezing of the stone	Shock wave is broader than the stone Shock wave velocity is lower in the water than in the stone	Nutcracker-like action requiring large focal diameters	Only relevant for large focal zones



Cavitation

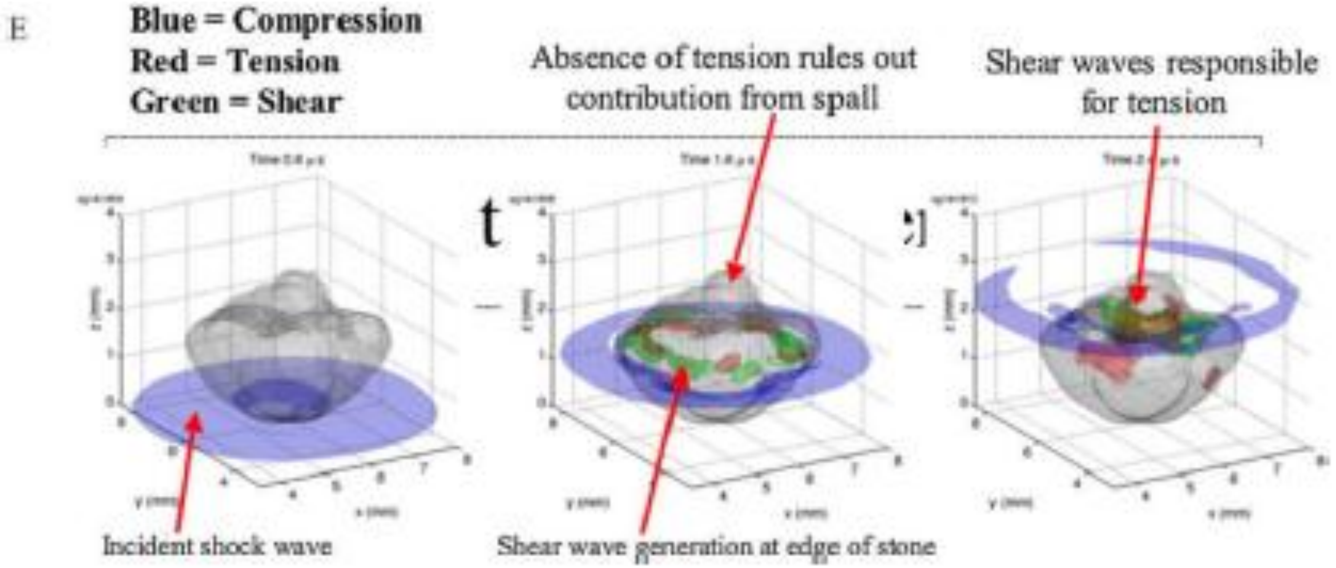
Hypothesis	Mechanism	Prerequisites	Type of action	Comments
Cavitation [10]	Negative pressure waves induce a collapsing cavitation bubble at the stone surface	Low viscosity of surrounding medium	Microexplosive erosion at the proximal and distal ends of the stone	More important during stone comminution Useful for improving the efficiency of shock waves (ie, EHL)

D

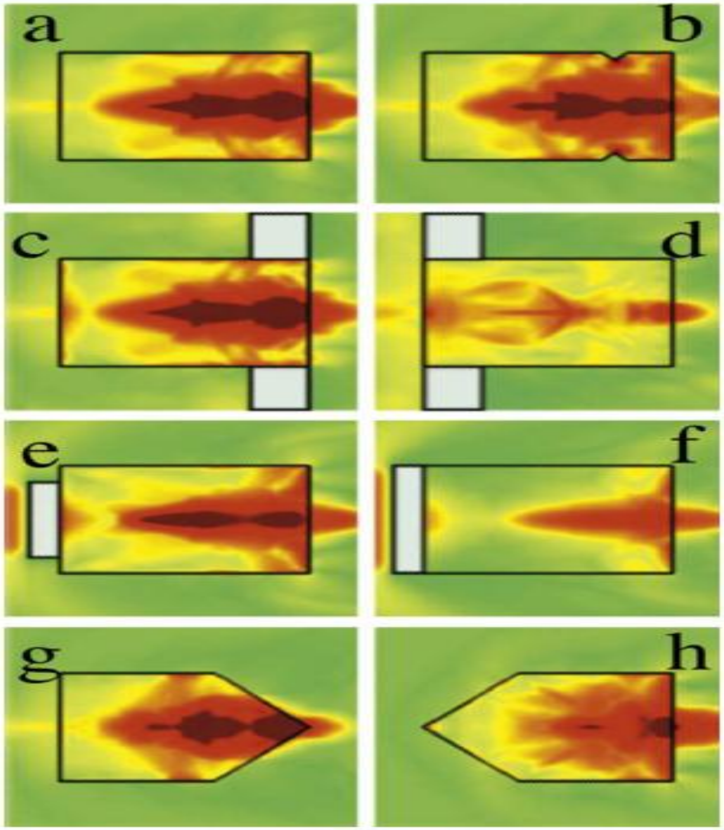


Dynamic Squeezing

Hypothesis	Mechanism	Prerequisites	Type of action	Comments
Dynamic squeezing [12]	Shear waves initiated at the corner of the stone are reinforced by squeezing waves along the calculus	Parallel travelling of longitudinal waves Shock wave velocity is lower in the water than in the stone	Nutcracker-like action in combination with spalling	Best theory to explain results of the numerical model



Relevance of different theories



- ΣΑΣ ΕΥΧΑΡΙΣΤΩ

Table 3

Models and results of the experimental evaluation of stone fragmentation by shock waves (according to Sapozhnikov et al.[12]

Mechanism	Model	Hypothesis	Stone model/numerical calculation
Spallation	Stone length: 8–18 mm	Stone fractures at the same distance from the distal end	Stone fractures at a third of the way from the distal end dependent on length
	Block of proximal surface by corprene disk	Stone fracture is significantly inhibited	Little difference (50 vs 45 shock waves) Pressure field similar at the last third
Squeezing	Baffle ringing the proximal end	Stone fracture is significantly inhibited	Significant inhibition (300 vs 45 shock waves) but reduced stress field still at the last third
	Conical shape of the stone front	Stone fracture is not inhibited	Significant inhibition (200 vs 45 shock waves) Pressure field reduced because of diffraction
	Block of proximal end (complete)	Stone fracture is not inhibited	Significant inhibition (212 vs 45 shock waves) Pressure field reduced because of absorption