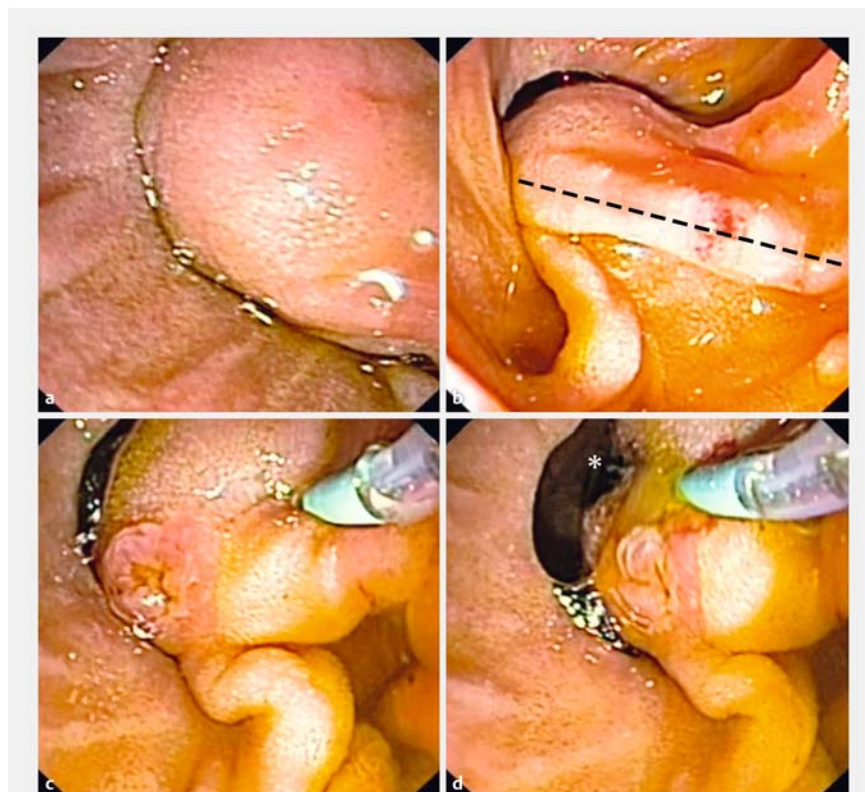


## Novel unroofing approach for incipient suprapapillary stone perforation causing papillary invagination (“the crescent sign”)

This is the case of an 89-year-old man undergoing emergency endoscopic retrograde cholangiography (ERC) for acute cholangitis. However, no en face view of the papilla was obtained after duodenoscope advancement but instead an edematous bulky mass surrounded by a semilunar slit was visible. ▶ **Fig. 1 a, b** depicts the level of the papilla in the short and long axes, providing crescent-like clues to the diagnosis (“the crescent sign”). “High grade” edema with “papillary invagination” was confirmed by papillotome traction after probing the slit (▶ **Fig. 1 c**). Further palpation revealed an incipient suprapapillary stone perforation (▶ **Fig. 1 d**).

Conventional biliary access using various cannulae and techniques was unsuccessful. Therefore, we proceeded with an “unroofing” approach, cutting along the axis from the papilla to the perforation site (▶ **Fig. 2 a, b**), exposing the large impacted stone (▶ **Fig. 2 c**). Selective biliary cannulation was achieved thereafter, and the stone subsequently passed (▶ **Fig. 2 d**). ▶ **Fig. 2 e** shows the flattened papillary mound at the 3 o’clock position (▶ **Video 1**). Next, an extensional guide-wire-directed papillotomy along the bile duct axis was performed, and a stent was placed because of the remnant stone burden.

This unique report incorporates several novelties in both diagnostic and therapeutic approaches to bile duct stone impaction in the setting of a periampullary diverticulum (PAD) [1]. It is the first report of an occlusive infolding of the papillary region into a PAD due to stone-related high-grade edema and axial distortion. Extending the spectrum of a “hidden papilla” in PAD, “the crescent sign” reflects what we may designate “papillary invagination,” albeit not in its strictest sense [2]. Endoscopic manage-



▶ **Fig. 1** Diagnostic part—“The crescent sign” suggesting papillary invagination in the periampullary diverticulum related to incipient suprapapillary stone perforation. Duodenoscopic view at the level of the papilla in the short (a) and long (b) axes, revealing an edematous bulky mass surrounded by a crescent-shaped slit and a distorted longitudinal fold (dotted line in b). c Exposure of the papillary opening after papillotome traction. d Incomplete dorso-cranial suprapapillary stone perforation (asterisk).

ment of incomplete stone perforation requires individualization, with options including standard papillotomy, needle-knife papillotomy, or the presented “unroofing” approach [3].

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### Competing interests

None

### The Authors

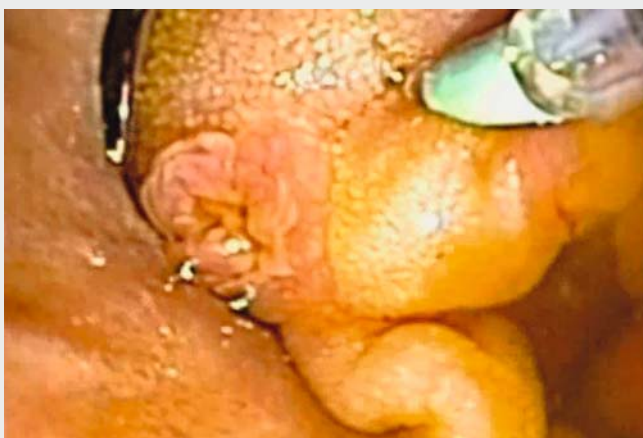
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► **Fig. 2** Therapeutic part – Novel “unroofing” approach for initial biliary access. **a** Deliberate cannulation from the papilla to the perforation site (asterisk, tip of the papillotome). **b** “Unroofing” by cutting along the axis from the papilla to the perforation site, similarly to conventional papillotomy. **c** Papillotome palpation exposed the entire stone. **d** Stone passage after biliary cannulation with a straight cannula. **e** Flattened papillary region after the intervention.



► **Video 1** The video showcases a novel diagnostic finding, for which the introduction of the term “papillary invagination” is suggested and which might be indicated by “the crescent sign.” Furthermore, an innovative therapeutic approach to incomplete suprapapillary stone perforation in a setting of periampullary diverticulum is presented (i.e. an “unroofing” procedure cutting along the axis from the papilla orifice to the perforation site).

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