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Extended anterior approach to the entire length of the humerus

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Introduction: Selecting the surgical approach for a humeral shaft fracture depends on type and location of the fracture (**Fig. 1**). Distal extension of the anterior approach to the humerus is difficult because neurovascular structures converge at the anterolateral aspect of the elbow (**Fig. 3**). Many surgeons are unfamiliar with the specific anatomical features of this region. The aim of the present study was to clarify the anatomy of the anterior approach to the entire humerus with respect to important neurovascular structures.

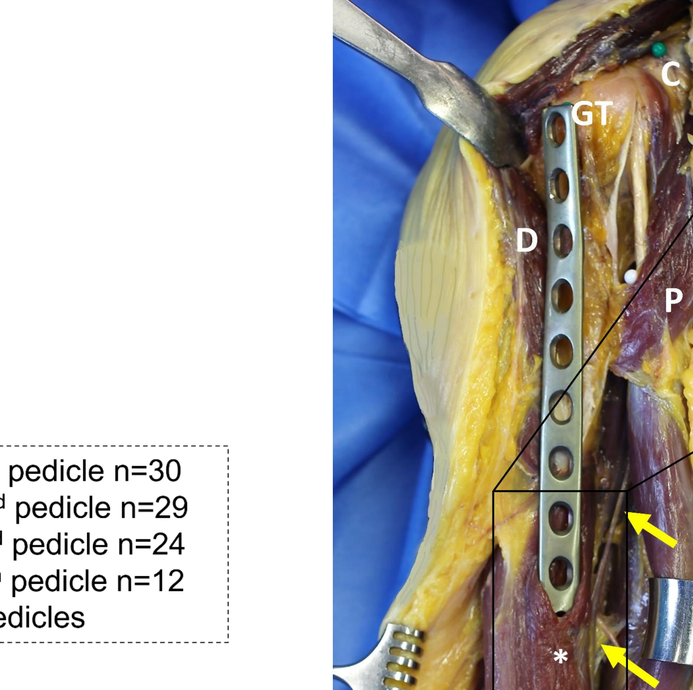

Fig. 1: ORIF pathological fracture right humerus.

Methods: An extended anterior approach was performed on 30 cadaveric upper arms. A plate was adjusted helically from the greater tuberosity underneath the brachialis muscle (BR) to the coronoid fossa (**Fig. 3**). BR splitting was limited to the plate holes by blunt dissection, preserving intramuscular crossing neurovascular pedicles (**Fig.3 blue arrows**). The distances were measured from the plate to adjacent neurovascular structures. The innervation pattern of the BR was revealed and the potential risk of denervation during surgery was assessed.

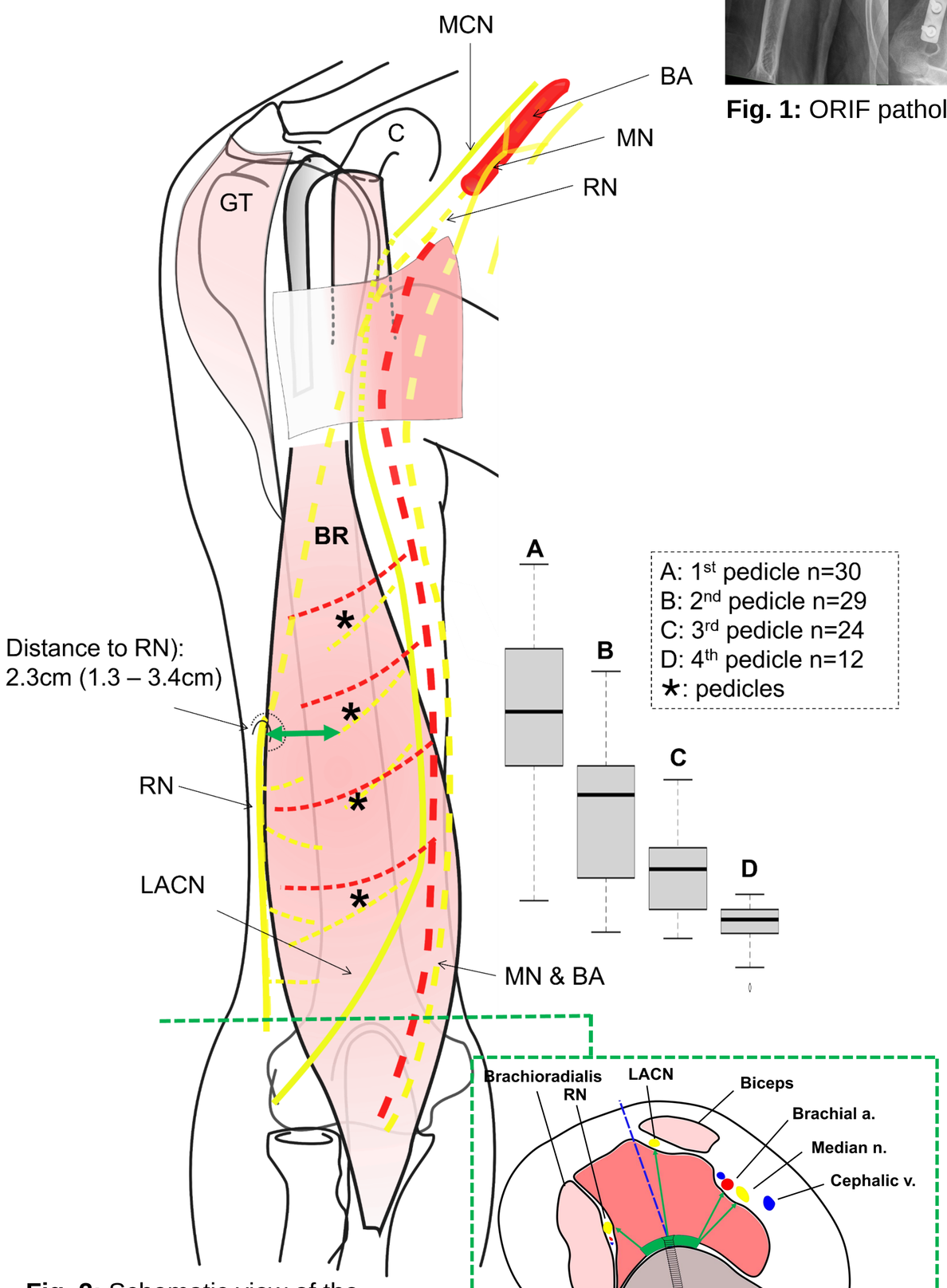

Fig. 2: Schematic view of the humerus with the corresponding box plots illustrating the levels of the brachialis (BR) crossing pedicles. A cross section through the distal humerus (green dotted line) at the level of the distal end of the plate demonstrates the safe distances to the adjacent neurovascular structures

Tbl. 1: Distances from the superior border of the coronoid fossa to the adjacent neurovascular structures.

Tbl. 1: Distances from superior border of the coronoid fossa (mm)

	mean	*sd*	*min*	*max*
LACN	22.9	4.9	14	34
RN	22	4.7	11	29
MN	25	4.5	17	36
BA	23.5	3.3	17	29

Fig. 3: Specimen with a narrow 4.5 LC-DCP plate along the entire length of the humerus, placed distally behind the BR. The yellow arrows indicate the MCN and its intramuscular distribution (blue arrows). Utilizing the brachialis-sparing approach prevents extensive denervation of the BR. The interval between BR and brachioradialis (Brr) remains untouched and the radial nerve secured. Biceps (B).

Results: Anterior application of a helically contoured plate to the entire humerus was performed. Figure and table 2 summarizes the distances from the border of the plate to important neurovascular structures at risk. Besides the musculocutaneus nerve (MCN), branches of the radial nerve (RN) supply the BR in up to 90%. The latter consisted regularly of 3-4 intramuscular crossing neurovascular pedicle-containing branches of the MCN and the brachial artery. One out of 30 specimens presented with a triple BR innervation (MCN, RN and median nerve (MN)).

Conclusions: The anterior approach to the entire humerus can be performed safely. Identifying the BR crossing neurovascular pedicles prevents damaging the muscle innervation. The RN runs at a safe distance to the helically shaped plate. With the accurate brachialis splitting technique identifying and mobilizing the RN is not compulsory . An extended anterior approach to the humerus offers an advantageous alternative to the posterior, lateral or two-incision approaches.

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