

Assessing the variability in clavicular anatomy: a cadaveric study

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INTRODUCTION

The variable and complex sigmoid shaped anatomy of the clavicle can present a challenge for surgeons when operative repair is required. Recently, pre-contoured plates which propose to precisely fit the anatomical shape of the clavicle have become available (Figure 1). Through their use in our local unit, problems have arisen with these devices with a mismatch between plate and clavicular anatomy occurring at a notable rate.

This study therefore aims to review the anatomy of the clavicle and its variations.



Figure 1 - Pre-contoured clavicle plate

METHOD

This study used 143 dry unpaired clavicles (64 left and 79 right). Any clavicles found to have incomplete bony anatomy or fractures were discounted before the beginning of the project. Provenance, age, sex, body size, handedness, body weight and circumstances of death of the donors were unknown.

Each clavicle was photographed on a grid with an adjacent scale. Electronic callipers were used to take measurements from each photograph of six pre-defined points on each clavicle. Statistical analysis was carried out on the results. Measurements were taken as follows (Figure 2).

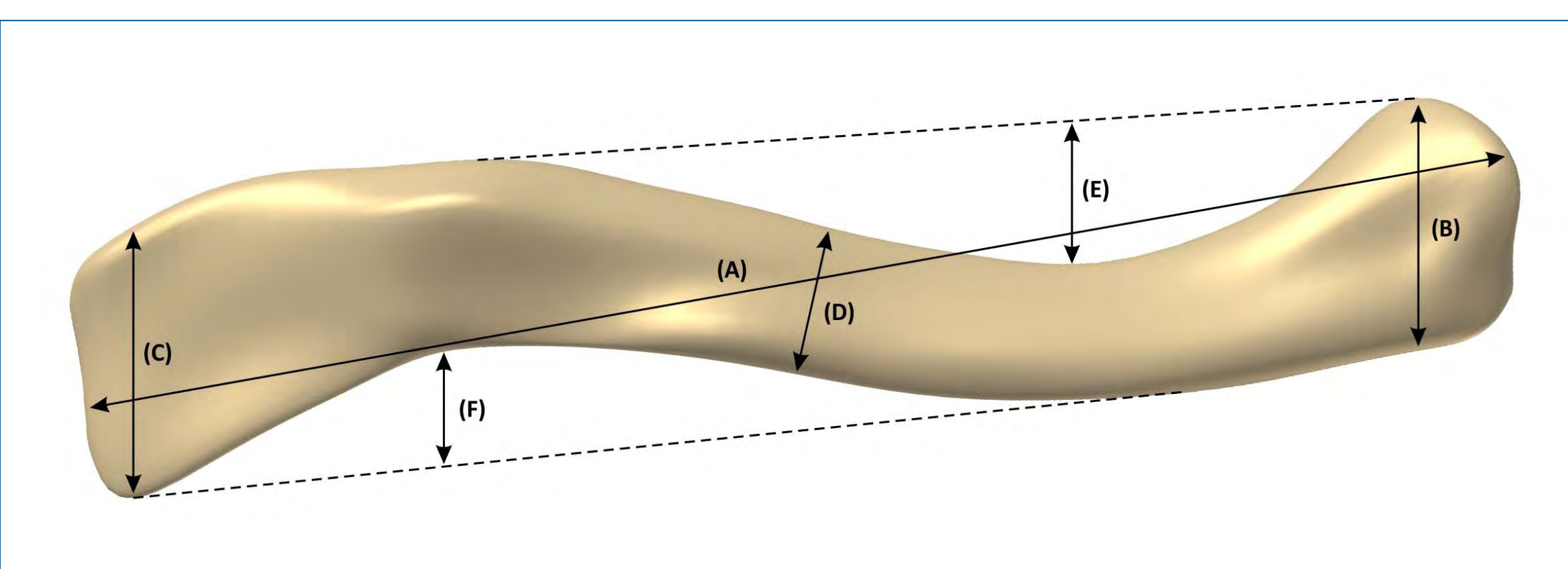


Figure 2 - (A) Length; (B) Diameter medial end (C) Diameter lateral end; (D) Diameter mid-clavicular segment; (E) Depth of medial curvature; (F) Depth of lateral curvature

• LENGTH (A):

The distance between the maximum projection of the lateral end (acromial side) and the most prominent point of the anterior edge of the most medial end (sternal side).

• MEDIAL END DIAMETER (B):

Widest part of medial end of the clavicle.

• LATERAL END DIAMETER (C):

Widest part of lateral end of the clavicle.

• DIAMETER MID-CLAVICULAR SEGMENT (D):

Measured from the shaft, at its midpoint of the clavicle - calculated as half of the length.

• DEPTH OF MEDIAL CURVATURE (E):

A line was drawn between the superior aspect of the sternal end of the bone and the most prominent aspect of the lateral convexity. The depth of the medial curvature was then taken as the length of a line perpendicular to this, which touched the deepest point of the medial concavity.

• DEPTH OF LATERAL CURVATURE (F):

A line was drawn between the inferior aspect of the acromial end of the bone and the most prominent aspect of the medial convexity. The depth of the lateral curvature was then taken as the length of a line perpendicular to this, which touched the deepest point of the lateral concavity.

RESULTS

	Range (cm)	Mean (cm)	Right Side Mean (cm)	Left Side Mean (cm)
Length	10.93-18.34	14.97	14.83	15.14
Diameter				
Mid-Clavicular Segment	0.78-1.85	1.15	1.11	1.19
Lateral (Acromial) End	1.66-3.65	2.54	2.57	2.5
Medial (Sternal) End	1.68-3.41	2.36	2.37	2.35
Curvatures				
Lateral	0.46-3.39	1.28	1.30	1.26
Medial	0.97-2.66	1.87	1.86	1.88

DISCUSSION

- Our series demonstrated a wide range in clavicular length, spanning 7.41cm. The mean length, of 14.97 ± 1.38 cm, is in keeping with that of similar studies^{1,2,3,4}.
- Left clavicles were in general longer than right (15.14 ± 1.48 cm vs. 14.83 ± 1.30 cm) and had a mid-clavicular segment larger and showing a significantly wider range (1.07cm vs. 0.72cm on the right).
- significant variation was found in the diameter of both the acromial and sternal ends, although on average little difference in diameter existed between the two structures.
- Left acromial ends were found to have a slightly shorter diameter than on the right (2.50 ± 0.39 cm vs. 2.57 ± 0.45 cm). Right sternal ends were also found to be longer than the left at 2.37 ± 0.35 cm (vs. 2.35 ± 0.30 on the left).
- The lateral curvatures showed more variation in depth than the medial curvatures (2.93 ± 0.46 cm vs. 1.69 ± 0.33 cm medially), however largest depth on average belonged to the medial curvatures. These findings are in keeping with other studies reviewed^{1,2}.

CONCLUSION

The results outline the wide range of potential differences in the dimensions of the clavicle.

With the diverse range of measurements obtained, especially those regarding clavicle lengths and depths of curvatures, it is appropriate to suggest these anatomical variations pose a problem for the design of "anatomically specific" pre-contoured fracture fixation plates.

It is hoped the data presented will contribute not only to the knowledge of clavicular anatomy but also in the future design of such pre-contoured fixation devices.

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