Bone shortening of clavicular fractures: comparison of measurement methods

Thorsmark AH[1], Udby P[2], Ban I[2], Frich LH[3]

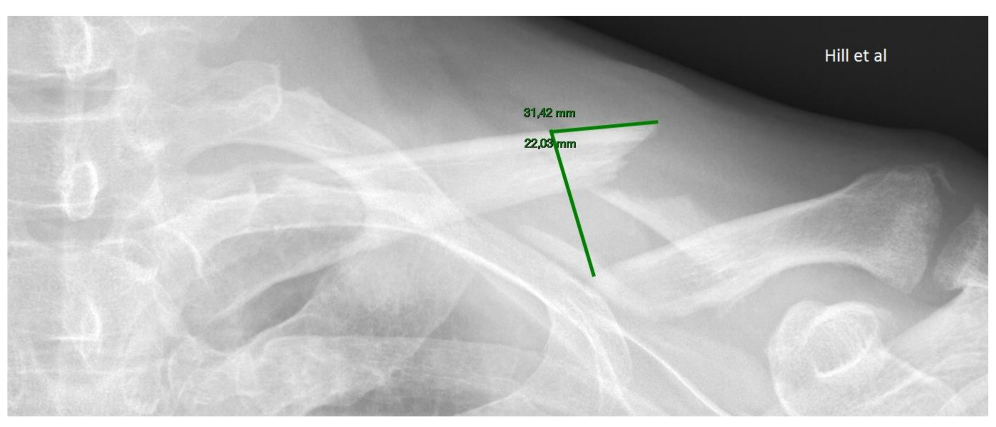
1: Holbæk Hospital: Dept. of Orthopedic Surgery and Traumatology

2: Hvidovre University Hospital: Clinical Orthopedic Research Hvidovre, Dept. of Orthopedic Surgery and Traumatology

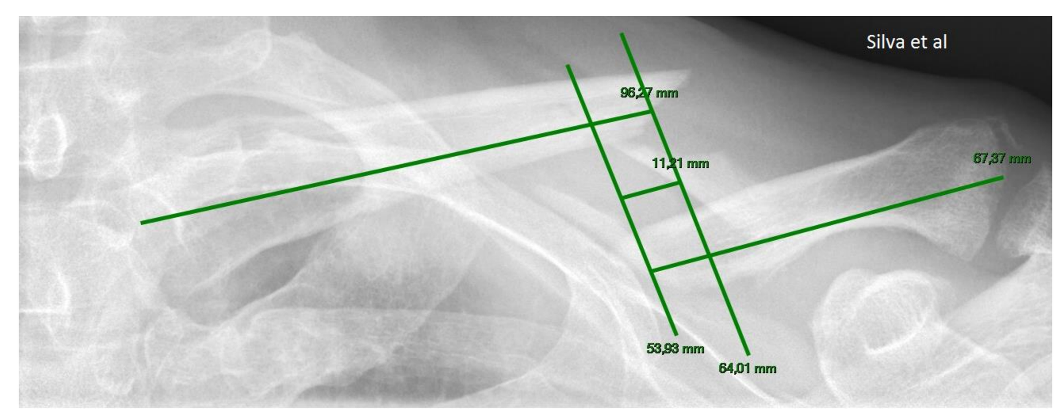
3: Odense University Hospital: Orthopedic Research Unit, Dept. of Orthopedic Surgery and Traumatology

Introduction

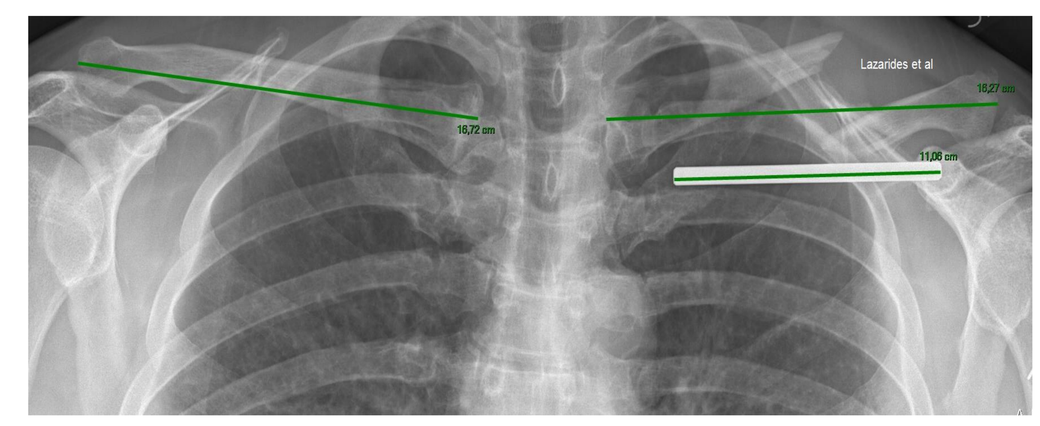
Clavicle fractures are common and represent close to 7% of all fractures. Bone shortening following a clavicle fracture has often been associated to adverse patient outcomes and is one of the main factors used to allocate operative care. Three methods have been described for estimating bone shortening (see figures). It is not known if these methods are interchangeable.



Hill: a line is drawn from the bottom fragment perpendidular to the top fragment. Bone shortening is defined from line to the tip of the top fragment.



Silva: a line is drawn through the middle of each fragment. From each middle line a perpendular line between each fragment is drawn. Bone shortening is defined as the distance between the perpendular lines.



Lazardis: length of each clavicle is measured. Bone shortening is defined as uninjured clavicle length minus injured clavicle length

Objectives

Aim of this study was to (i) estimate the inter- and intra observer reliability as well as (ii) agreement and the validity comparing the methods.

Methods

The study was a retrospective comparative study based on 60 patients with acute displaced midshaft clavicle fractures. Bone shortening was measured by two investigator, blinded to eachother, at five separate sessions.

Results

Reliability (Table 1). Reliability was estimated using intraclass correlation, ICC. Agreement was estimated using the standard error of measurement, SEM, and minimal detectable change, MDC.

Inter method agreement (Table 2) Validity was estimated using Bland-Altman plots, mean differences and limits of agreement, LOA and Pearsons correlation R was also calculated.

Table 1

Reliability bone shortening	ICC	mean (mm)	SD crude (mm)	SEM (mm)	MDC (mm)
Silva et al					
interobserver	0.864	12.9	11.8	4.4	12.1
interobserver	0.908	25.5	13.3	4	11.2
intraobserver	0.874	20.6	13.4	4.8	13.2
Hill et al					
interobserver	0.871	23.2	11.8	4.2	11.7
interobserver	0.878	21.4	12.5	4.4	12.1
intraobserver	0.907	22.3	12.2	3.7	10.3
Lazarides et al					
interobserver	0.942	7.8	11.8	2.8	7.9
interobserver	0.945	7.7	12.0	2.8	7.8
intraobserver	0.965	7.7	11.9	2.2	6.2

Table 2

Inter method agreement bone shortening	Mean difference (mm)	Bland-Altman Limits of agreement (LOA) – 95 % CI	Pearsons correlation R
Silva vs Hill			
interobserver	-7.5	-23 to 8	0.775
interobserver	4.1	-14 to 22	0.752
intraobserver	1.7	-19 to 22	0.679
Silva vs Lazarides			
interobserver	7.8	-19 to 35	0.303
interobserver	17.8	-13 to 49	0.225
intraobserver	12.8	-19 to 43	0.240
Hill vs Lazarides			
interobserver	15.3	-12 to 43	0.27
interobserver	13.7	-18 to 45	0.137
intraobserver	14.5	-15 to 43	0.200

Conclusion

All three methods seemed to be reliably testing both inter and intra observer reliability. However the method by Lazarides had the best agreement based on SEM and MDC. The other two methods had a relative high MDC making their clinical use unreliable. The methods by Hill et al and Silva et al. were somewhat correlated by Pearsons correlation R and mean difference but with very wide LOA, whereas the method by Lazarides was not correlated to the others on Pearsons correlation R nor by mean difference and LOA.

Whether bone shortening results in adverse outcome is still debatable, but if used in a clinical setting it is important to have a reliably and accurate estimate. Based on this study the method by Lazarides is the most accurate and reliably. If shortening is to influence the treatment then panorama radiographs should be introduced as a standard.

University of Southern Denmark

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