Original Article The Journal of Hand Surgery (Asian-Pacific Volume) 2023;28(2):192-196 • DOI: 10.1142/S2424835523500200

Practice Variation in Proximal Phalangeal Fracture Management

Brahman SIVAKUMAR[*,†,‡], Mark ROSS[§,¶,**], David J. GRAHAM[†,††,‡‡]

[*]*Department of Hand and Peripheral Nerve Surgery, Royal North Shore Hospital, NSW, Australia*
[†]*Australian Research Collaboration on Hands (ARCH), Mudgeeraba, QLD, Australia*
[‡]*The University of Sydney, Department of Surgery, Faculty of Medicine, Camperdown, NSW, Australia*
[§]*Brisbane Hand and Upper Limb Research Institute, Brisbane Private Hospital, Spring Hill, QLD, Australia*
[¶]*School of Medicine, The University of Queensland, St Lucia, QLD, Australia*
[**]*The Princess Alexandra Hospital, Woolloongabba, QLD, Australia*
[††]*Department of Musculoskeletal Services, Gold Coast University Hospital, Southport, QLD, Australia*
[‡‡]*Griffith University School of Medicine and Dentistry, Southport, QLD, Australia*

Background: Practice variation may indicate a lack of evidence to guide management. This study investigated the preferences of operative management of proximal phalangeal fractures in Australian hand surgeons, as well as factors that may account for variations.

Methods: An electronic survey of all members of the Australian Hand Surgery Society was performed. Surgeon demographic factors and surgical preferences were investigated. Three common proximal phalangeal fracture configurations were presented as cases. Potential predictors of management were explored.

Results: A total of 51.9% of active hand surgeons responded. Orthopaedic surgeons were more comfortable with lateral plating and intramedullary screw fixation, while plastic surgeons preferred Kirschner wire (K-wire) fixation. Junior surgeons were more likely to believe that intramedullary screw fixation produced superior results. 53.0% of surgeons in a tertiary environment believed that adequate hand therapy was key (compared to 17.0% of clinicians in a secondary hospital).

Conclusions: There is significant practice variation and a lack of standards in the management of a common clinical problem, as well as a lack of consensus on the evidence underpinning common fixation methods. Further research is needed.

Level of Evidence: Level IV (Therapeutic)

Keywords: *Proximal phalanx, P1, Practice variation, Fracture, Fixation*

INTRODUCTION

Phalangeal fractures are the second most common fracture in the upper limb, with the proximal phalanx injured as commonly as its distal counterparts.[1,2] Surgical management in proximal phalangeal fractures that require stabilisation aims to create a biomechanical environment capable of withstanding the forces applied through early active (and ideally passive) range of motion exercises, while minimising impediments to tendon glide through mechanical blockage or scarring as a result of dissection. A number of treatment modalities exist, and

Received: Sep. 29, 2022; Accepted: Jan. 13, 2023
Published online: Apr. 17, 2023
Correspondence to: David Graham
Australian Research Collaboration on Hands (ARCH)
4/75 Railway St, Mudgeeraba
QLD 4213, Australia
Tel: +61-755-980-194, Fax: +61-755-963-537
E-mail: davegraham80@gmail.com

may be dictated by fracture configuration, soft tissue status, patient factors, surgeon preference and the available evidence.

Although systematic reviews of large, well-designed randomised controlled trials (RCTs) provide the highest level of evidence to guide surgical management, they may be limited by the quality of the underlying research. Surgical randomised trials are sparse and can be difficult to perform, as they may involve complex procedures, often engage heterogenous populations and injuries, must account for learning curves and are frequently difficult to blind.[2] When high-quality evidence is lacking, surgical decision-making and practice variation may be driven by conscious and unconscious surgeon biases, level of experience, practice setting and training.

Although rigid fixation has been shown to confer significantly better outcomes than non-rigid constructs (facilitating more precise alignment and earlier mobilisation), the ideal method of proximal phalangeal fracture stabilisation is yet to be identified.[3–5] Differing approaches and plate positions have been suggested to spare the extensor apparatus and maintain range of motion; intramedullary fixation has also been gaining popularity to balance the conflicting concerns of soft tissue dissection and construct stability.[1–6] However, no consensus currently exists.

Thus, the purpose of this study was to investigate the preferences of operative management of proximal phalangeal fractures among Australian hand surgeons and to explore factors that may account for variations.

METHODS

After obtaining clearance from the institutional ethics review committee, an electronic survey was sent to all members of the Australian Hand Surgery Society (AHSS). The AHSS is the peak body for hand surgery in Australia, with requirements of membership including Fellowship of the Royal Australasian College of Surgeons (FRACS) or an equivalent, and formal training in hand surgery. Members generally have a background in either orthopaedic or plastic surgery, or, less commonly, general surgery. The survey was distributed in early April 2021, and was open for a 2-week period, with a number of reminder e-mails sent within that duration. All participants were offered the chance to win an iPad mini (Apple Inc., Cupertino, CA, USA) to boost participation.

The survey consisted of two sections. The first collated information about the surgeon's demographic background and experience, including base surgical specialty, number of years in practice, Practice and hospital setting and participation in hand trauma on-call rosters. The second evaluated preferences in the management of proximal phalangeal fractures, before presenting three cases (proximal metaphyseal, mid-shaft and sub-capital fractures) with a number of operative and non-operative measures for selection of intervention.

Surveys that were not at least 50% complete were excluded from the analysis. The survey questions were summarised to indicate the proportion of surgeons selecting each response, and then stratified by base specialty (orthopaedic/plastic/other), duration in practice (<10 years, as compared to greater than this period), practice setting (secondary, tertiary or both) and number of phalanges operated on per year (<12; 12–30 or >30) to determine trends. Statistical testing was conducted using chi-squared tests to explore relationships between group categories and responses for each question in the survey. A p-value of <0.05 was regarded as statistically significant. Wincross Version 15 (Scottsdale, AZ, USA) was utilised for cross-tabulation and data analysis.

RESULTS

The AHSS has 236 members, of whom 28 are retired surgeons and 21 are corresponding members (based in New Zealand). No response was expected from these sub-groups, yielding a cohort of 187 active hand surgeons based in Australia. A total of 107 survey responses were received, with 10 entries excluded for being less than 50% completed. 97 responses were included for data analysis, a survey response rate of 51.9% of active Australian hand surgeons (or 41.1% of all AHSS members).

A total of 64.9% (n = 63) of respondents identified as orthopaedic surgeons, with 33.0% (n = 32) claiming plastic surgical training, and the remainder hailing from another base specialty. Of the surgeons, 41.2% had been practising hand surgery for less than 10 years, with the remainder for a longer duration. A total of 25.8% of respondents were employed in a secondary setting only; 43.3% worked in a tertiary hospital alone; and 30.9% worked in both.

Although almost all of the responding surgeons were currently involved in the treatment of hand trauma (96.9%, n = 94), more than a third (35.1%, n = 34) did not participate in an on-call trauma roster. Surgeons who had been in practice for a shorter duration were significantly more likely to participate in an on-call hand trauma roster (chi-square = 12.02, p = 0.0005) and manage more proximal phalangeal fractures (chi-square = 12.24,

$p = 0.007$, refer Table 1). Surgeons employed in tertiary centres treated more proximal phalangeal fractures than those employed in secondary centres alone (chi-square = 18.82, $p = 0.005$); in the same vein, metropolitan settings led to a greater exposure to proximal phalangeal injuries annually when compared to rural or regional locations (chi-square = 10.24, $p = 0.037$).

When comparing surgical biases towards fixation methods in displaced extra-articular phalangeal fractures, there was a wide spread of preferences between the various options, although the majority of surgeons ($n = 55$, 57.3%) felt comfortable with dorsal plating (refer Table 2). A statistically significant association was noted between specialty and preferred surgical techniques (chi-square = 14.35, $p = 0.045$), with orthopaedic surgeons being more comfortable with techniques such as lateral plating and intramedullary screw fixation, while plastic surgeons preferred crossed Kirschner-wire (K-wire) stabilisation. A higher proportion of surgeons with less experience believed that intramedullary screw fixation produced superior clinical results, when compared to more experienced surgeons (chi-square = 14.42, $p = 0.025$).

Surgeons also expressed a significant discordance with requirement for secondary hardware removal based on volume of proximal phalangeal fractures managed – for example, approximately 60% of clinicians operating on < 30 injuries per year believed that dorsal plating required secondary removal, compared to 25% of those with a higher volume. Although not significant, plastic surgeons were more likely to feel comfortable allowing a trainee to perform crossed K-wire fixation unsupervised (44.4% vs. 21.7% of orthopods), while orthopaedic surgeons were more at ease letting their juniors apply a dorsal plate without direction (50.0% vs. 29.6%). A

Table 1. Number of Proximal Phalangeal Fractures Operated on Per Year, Stratified by Variables

Proximal phalanges operated on/year	Total	Speciality		Years as hand surgeon		Hospital setting		
		Orthopaedic	Plastic surgery	<10 years	11+ years	Tertiary	Secondary	Both
Total	94	61	31	40	54	40	25	29
0	-	-	-	-	-	-	-	-
<5	7 (7.4%)	3 (4.9%)	3 (9.7%)	2 (5.0%)	5 (9.3%)	1 (2.5%)	3 (12.0%)	3 (10.3%)
5–11	21 (22.3%)	13 (21.3%)	7 (22.6%)	4 (10.0%)	17 (31.5%)	4 (10.0%)	12 (48.0%)	5 (17.2%)
12–30	50 (53.2%)	38 (62.3%)	12 (38.7%)	22 (55.0%)	28 (51.9%)	25 (62.5%)	9 (36.0%)	16 (55.2%)
>30	16 (17.0%)	7 (11.5%)	9 (29.0%)	12 (30.0%)	4 (7.4%)	10 (25.0%)	1 (4.0%)	5 (17.2%)
Chi-square		<----6.48----->		←---12.24---→		←--------18.82--------→		
P-value		0.0906		**0.0066**		**0.0045**		

Table 2. Statistically Significant Associations between Preferred Therapeutic Modalities and Surgeon Variable

Surgical option	Speciality		Years as hand surgeon		Phalanges/year		
	Orthopaedic	Plastic surgery	<10 years	11+ years	<12	12–30	>30
Question	***Preferred surgical techniques****		***Superior clinical outcome***		***Require hardware removal***		
Total answering	63	31	39	57	26	48	12
ORIF with dorsal plate [tendon-splitting approach]	35 (55.6%)	19 (61.3%)	4 (10.3%)	12 (21.1%)	15 (57.7%)	29 (60.4%)	3 (25.0%)
ORIF with lateral plate [tendon sparing approach]	20 (31.7%)	6 (19.4%)	5 (12.8%)	10 (17.5%)	0 (0.0%)	0 (0.0%)	1 (8.3%)
Lag screws only	31 (49.2%)	14 (45.2%)	13 (33.3%)	14 (24.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Crossed K-wires	9 (14.3%)	12 (38.7%)	2 (5.1%)	6 (10.5%)	8 (30.8%)	6 (12.5%)	2 (16.7%)
Intramedullary screw	14 (22.2%)	4 (12.9%)	11 (28.2%)	5 (8.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Trans-MPJ K-wires	6 (9.5%)	4 (12.9%)	2 (5.1%)	0 (0.0%)	0 (0.0%)	5 (10.4%)	1 (8.3%)
External fixation	6 (9.5%)	4 (12.9%)	0 (0.0%)	0 (0.0%)	2 (7.7%)	3 (6.3%)	3 (25.0%)
Other	6 (9.5%)	6 (19.4%)	2 (5.1%)	10 (17.5%)	1 (3.8%)	5 (10.4%)	2 (16.7%)
Chi-square	<---14.35--->		<------14.42------>		<--------19.47------->		
P-value	**0.0453**		**0.0253**		**0.0346**		

*Respondent able to choose multiple options.

significant difference in opinion was also noted between surgeons based in tertiary and secondary settings regarding the most important factor dictating postoperative outcome. While 53.0% of surgeons in a tertiary environment believed that adequate hand therapy was key (compared to 17.0% of clinicians in a secondary hospital), only 18.0% regarded surgical technique as the most important variable (vs. 54.0%, chi-square = 13.97, $p = 0.03$).

No significant trends were noted when considering surgical modalities with the least long-term sequelae, and those with the most supportive evidence, with a wide spread among all options. Similarly, no significant trends were demonstrated when considering the presented clinical cases. Although greater than 40% of surgeons utilised dorsal plating for all fracture locations, preferences for other surgical modalities were widely distributed.

DISCUSSION

Proximal phalangeal fractures are common, and although the majority are stable and can be adequately managed non-operatively, in a subset of cases a satisfactory reduction cannot be obtained or maintained, leading to the need for surgical intervention. In general, the rate of operative intervention of hand fractures has increased over the last two decades.[7] A number of therapeutic modalities exist, each with their own advantages and drawbacks. K-wire fixation is minimally invasive, inexpensive and time efficient and can be implemented through extra-articular or intra-articular (trans-metacarpophalangeal joint) approaches. However, clinical and biomechanical studies indicate that K-wiring confers inferior stability when compared to plate fixation, and may tether the extensor apparatus, lead to pin-site infections and impair early mobilisation.[3–8]

Plates have traditionally been placed on the flat dorsal surface of the proximal phalanx through an extensor tendon-splitting approach, facilitating fracture visualisation and reduction, precise alignment and rigid fixation. However, greater soft tissue dissection with resultant adhesion formation and intimate contact with the extensor apparatus may result in poorer clinical outcomes. To circumvent these issues, tendon sparing approaches with lateral or dorsolateral plate positioning have been suggested. The authors earlier performed a systematic review and meta-analysis of the available literature comparing extensor tendon-splitting and sparing approaches. Although limited by quality and quantity of studies available for inclusion, a significant improvement in total active motion (TAM) of approximately 9º when the tendon is not violated[6] was found. Intramedullary headless compression screw fixation has also been advocated to address the conflicting concerns of minimising tendon disturbance and obtaining construct stability, with novel approaches expanding the range of fractures in which this modality can be utilised.[13] A recent literature review found a TAM superior to any reported post plating, although a lack of comparative studies precluded meta-analysis.[1] However, no consensus exists as to ideal management.

This survey finds considerable practice variation among Australian hand surgeons in the operative management of proximal phalangeal fractures. Specifically, decision-making was influenced by base surgical training, with orthopaedic surgeons demonstrating more comfort applying lateral plates and intramedullary screws (and allowing trainees to insert plates unsupervised), while plastic surgeons were at greater ease inserting K-wires. Less experienced surgeons were also more likely to advocate for intramedullary screw fixation, which may reflect changes in training programmes, exposure to newer technology and techniques, or less personal experience with adverse outcomes.[2] Surgeons with a greater volume of proximal phalangeal fractures provided a lower estimate of the rate of plate removal following a dorsal tendon-splitting approach. This may be due to greater experience with resultant technical superiority; alternatively, it may be reflective of a previously described phenomenon whereby surgeons with a higher procedure volume demonstrate greater enthusiasm than those with a lower volume.[9] Lastly, surgeons in tertiary hospitals believed in the primal importance of hand therapy for satisfactory clinical outcomes, while those in secondary settings emphasised surgical technique. This may be due to a closer collaboration between surgeons and hand therapists in tertiary-referral institutes; more experienced hand therapy staff at these institutions; and a resultant exposure to the benefits of adequate rehabilitation.

Prior authors have suggested concordance of at least 80% to establish clinical agreement, with >95% agreement a 'practice standard'.[2,9,10] None of the listed techniques hit this threshold, and thus can be considered practice options only. Lack of practice standards may lead to financial and resource inefficiencies, as well as sub-optimal patient management by surgeons who may be guided by personal preferences, exposure and training biases, as opposed to high-level evidence.

This study has several limitations. It was distributed electronically, which may be predisposed to responses from younger and more technologically savvy surgeons,

potentially influencing the results. Similarly, a survey response rate of between approximately 40%–50%, while on par or better than standard physician response rates, may limit generalisability and lead to bias.[11] Years in practice was utilised as a proxy for clinical experience (as has been previously performed) but may not be an accurate surrogate of proficiency.[2]

Despite the limitations, this study identifies significant practice variation and a lack of standards in the management of a common condition. It also finds a lack of consensus on the evidence underpinning common fixation methods. A prospective RCT comparing outcomes following fixation via different treatment modalities (as well as large retrospective series) would be beneficial.

DECLARATIONS

Conflict of Interest: The authors DO not have any potential conflicts of interest with respect to this manuscript.

Funding: The authors received NO financial support for the preparation, research, authorship and/or publication of this manuscript.

Ethical Approval: Institutional ethics board approval granted.

Informed Consent: NO information in the submitted manuscript can be used to identify patients.

Acknowledgements: None.

REFERENCES

1. Sivakumar BS, An VVG, Graham DJ, Ledgard J, Lawson RD, Furniss D. Intramedullary compression screw fixation of proximal phalangeal fractures: A systematic literature review. *Hand (N Y)*. July 2022;17(4):595–601. https://doi.org/10.1177/1558944720928503.
2. Ansari U, Adie S, Harris IA, Naylor JM. Practice variation in common fracture presentations: A survey of orthopaedic surgeons. *Injury*. 2011;42(4):403–407. https://doi.org/10.1016/j.injury.2010.11.011.
3. Ip WY, Ng KH, Chow SP. A prospective study of 924 digital fractures of the hand. *Injury*. 1996;27(4):279–285. https://doi.org/10.1016/0020-1383(95)00222-7.
4. Fyfe IS, Mason S. The mechanical stability of internal fixation of fractured phalanges. *Hand*. 1979;11(1):50–54. https://doi.org/10.1016/S0072-968X(79)80009-1.
5. Reformat DD, Nores GG, Lam G, et al. Outcomes analysis of metacarpal and phalangeal fixation techniques at Bellevue Hospital. *Ann Plast Surg*. 2018;81(4):407–410. https://doi.org/10.1097/SAP.0000000000001581.
6. Sivakumar BS, An VVG, Phan K, et al. Range of motion following extensor tendon splitting vs. tendon sparing approaches for plate osteosynthesis of proximal phalangeal fractures – A systematic review and meta-analysis. *J Hand Surg Asian Pac Vol*. 2020;25(4):462–468. https://doi.org/10.1142/S2424835520500514.
7. Sivakumar BS, An VVG, Symes MJ, Graham DJ, Lawson RD, Clarke E. Temporal trends in the management of metacarpal and phalangeal fractures in the 21st century: An analysis of Australian population-based data. *ANZ J Surg*. 2022;92(10):2655–2660. https://doi.org/10.1111/ans.17818.
8. El-Saeed M, Sallam A, Radwan M, Metwally A. Kirschner wires versus titanium plates and screws in management of unstable phalangeal fractures: A randomized, controlled trial. *J Hand Surg Am*. 2019;44(12):1091.e1–1091.e10. https://doi.org/10.1016/j.jhsa.2019.01.015.
9. Dunn WR, Shackman BR, Walsh C, et al. Variation in orthopaedic surgeons' perceptions about the indications for rotator cuff surgery. *J Bone Joint Surg Am*. 2005;87:1978–1984. https://doi.org/10.2106/JBJS.D.02944.
10. Eddy DM. Clinical decision making: From theory to practice. Designing a practice policy. Standards, guidelines, and options. *JAMA*. 1990;263:3077–3084. https://doi.org/10.1001/jama.263.22.3077.
11. Kellerman SE, Herold J. Physician response to surveys? A review of the literature. *Am J Prev Med*. 2001;20(1):61–67. https://doi.org/10.1016/s0749-3797(00)00258-0.
12. Moura SP, Meulendijks MZ, Veeramani A, et al. Epidemiology and fracture patterns of traumatic phalangeal fractures. *Plast Reconstr Surg Glob Open*. 2022;10(8):e4455. https://doi.org/10.1097/GOX.0000000000004455.
13. Sivakumar BS, Graham DJ. Reverse instrumentation for headless compression screw fixation of basal proximal phalangeal fractures. *J Hand Surg Am*. February 22, 2023;S0363–5023(23)00002-3. https://doi.org/10.1016/j.jhsa.2022.12.012. Online ahead of print.