distributed, thus the Mann–Whitney *U* test was used to compare numerical data and the chi-squared test for categorical data. Statistical significance was accepted for two-tailed *p*-values < 0.05.

The baseline patient profiles, preoperative BCTQ symptom/function scores, VAS scores, nerve CSAs and mobility were not significantly different between the groups. All parameters showed significant improvement 3 months postoperatively, except for the amplitude of nerve mobility. Despite this significant improvement for both groups, no significant difference was found between Groups A and B regarding postoperative 3-month data and delta value (difference between preoperative and 3-month postoperative data for individual patients) for each parameter (Table 1).

Median nerve swelling significantly decreased for both groups, with no significant difference between groups 3 months postoperative. Recent studies have described a similar decreased nerve swelling with CTR, but showed that the reduction in CSA was not correlated with the degree of symptomatic improvement (Kim et al., 2016). Nanno et al. (2017) found a significantly smaller movement amplitude 1 month postoperatively and suggested that adhesions may still be present around the nerve, tendons and transverse carpal ligament. However, as the median nerve shifts palmarly, it avoids shearing and compression by adjacent tendons. The observed movement amplitude is a result of multiple factors, suggesting that, while median nerve CSA and mobility have been shown to be effective indicators for preoperative CTS severity (Kim et al., 2016; Kuo et al., 2016), they may not be reliable predictors for symptom relief postoperatively. We observed no significant change of nerve mobility 3 months postoperatively in both groups.

In our study, CTR resulted in significant improvement in BCTQ severity, VAS and decreased CSA of the median nerve 3 months postoperatively with no observed benefit of anti-adhesion gel application. These results are in line with Bilge et al. (2017), who concluded no significant difference in a postoperative, 1-year BCTQ score using anti-adhesion gel during CTR compared with CTR only. Our dynamic ultrasound evaluation showed that symptomatic improvement for CTR was also not correlated with increased nerve mobility at 3 months postoperatively. Lack of randomization and a small number of cases were limitations of our study.

Declaration of conflicting interests The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Informed consent Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

Ethical approval The research protocol was approved in advance by the appropriate ethical committee.

References

Bilge A, Ulusoy RG, Ozturk O, Ozturk IA, Aykut S. Carpal tunnel syndrome surgery anti-adhesion gel is effective? Acta Chir Orthop Traumatol Cech. 2017, 84: 391–5.

Kim JK, Koh YD, Kim JO, Choi SW. Changes in clinical symptoms, functions, and the median nerve cross-sectional area at the carpal tunnel inlet after open carpal tunnel release. Clin Orthop Surg. 2016, 8: 298–302.

Kuo TT, Lee MR, Liao YY, Chen JP, Hsu YW, Yeh CK. Assessment of median nerve mobility by ultrasound dynamic imaging for diagnosing carpal tunnel syndrome. PLoS One. 2016, 11: e0147051.

Nanno M, Kodera N, Tomori Y, Hagiwara Y, Takai S. Median nerve movement in the carpal tunnel before and after carpal tunnel release using transverse ultrasound. J Orthop Surg (Hong Kong). 2017, 25: 1–6.

Tang JB, Giddins G. Why and how to report surgeons' levels of expertise. The Journal of hand surgery, European volume. 2016, 41: 365–6.

I-Ning Lo[1,2], Po-Cheng Hsu[3] and Yi-Chao Huang[1,2]

[1]Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan

[2]Department of Orthopaedics, National Yang-Ming University, Taipei, Taiwan

[3]Department of Physical Medicine and Rehabilitation, Taipei Veterans General Hospital, Taipei, Taiwan

*Corresponding author: hcychuang@gmail.com

doi: 10.1177/1753193420952005 available online at http://jhs.sagepub.com

Reliability of the Masada and Jo classifications for multiple hereditary exostoses in the forearm

Dear Editor,

In 40–80% of children with multiple hereditary exostosis (MHE)/multiple osteochondroma disease, forearm bowing develops owing to distal ulnar growth disturbance. This may be mild to severe depending on the amount of ulnar shortening and associated bowing of the radius. In severe cases, the radial head (RH) may dislocate and lead to marked functional impairment, pain and deformity (Ham et al., 2016). Early distal osteochondroma excision and ulnar tether release has been shown to be

Figure 1. This example of multiple hereditary exostoses is difficult to classify. Surgeons rated this as IIa/b or 'not applicable' by the classification of Masada et al. (1989), whereas IIa/b, IVb or 'not applicable' were preferred using the categories of Jo et al. (2017). This case is prone to misinterpretation since raters may not notice a small osteochondroma. In this particular case, the osteochondromas were located in the mid-diaphysis and not distally.

beneficial in a small group of six patients (Belyea et al., 2020). There is no clear consensus on when to intervene and which osteochondromas need to be resected to prevent ongoing deformity.

The frequently cited study of Masada et al. (1989) contains a classification of this disease that distinguishes between the location of the osteochondromas (radius/ulna), the length of the radius and ulna, and whether or not RH dislocation is present. Four types are described: Type I (distal ulnar osteochondroma/short ulna), IIa (distal ulna/short ulna and proximal radial osteochondroma with RH dislocation), IIb (distal ulnar osteochondroma/short ulna with RH dislocation) and III (distal radial osteochondroma/short radius). To the best of our knowledge this classification has not yet been formally validated. There are indications that this system is incomplete and does not capture the entire spectrum of possible variations in the forearm. Jo et al. (2017) reported that 65% of MHE cases could not be classified using it. Therefore, they proposed additional Types IVa (distal ulnar and distal radial osteochondromas) and IVb (distal ulnar and distal radial osteochondromas with RH dislocation).

The aim of this study was to compare the inter- and intrarater reliabilities of these two classifications in a group of 15 paediatric upper limb surgeons. A representative sample of 20 consecutive MHE forearm radiographs (anterioposterior and lateral) were selected and distributed via an online survey tool (surveymonkey.com). The radiographs were sent out in a random order to be rated a second time after a 2-week interval. All raters were asked to classify all images using one of the four Masada and six Jo types; alternatively, the image could be rated as 'unclassifiable/not applicable' (Figure 1). We calculated the interrater reliability of the two systems using Fleiss' kappa and established any statistical difference between them using Hotelling's *T*-squared test. The intrarater reliability was established using Cohen's kappa. The statistical difference of unclassifiable cases between the classification systems was determined by a chi-squared test with Yates' correction for continuity.

The Masada classification showed a significantly lower interrater reliability for the first and second measurement series ($\kappa = 0.231$ and $\kappa = 0.230$) compared with the Jo classification ($\kappa = 0.357$ and $\kappa = 0.395$; $p = 0.022$ and $p = 0.011$). While the agreement according to Masada can thus be considered as only *fair* overall, it was borderline *moderate* in Jo's system. No statistically significant difference was found between the two-measurement series in both classifications ($p = 0.939$ and $p = 0.316$).

The median intrarater reliability among the group was $\kappa = 0.54$ (range 0.13–0.82) within Masada's system, and $\kappa = 0.60$ (range 0.25–0.83) within Jo's system. The ratings according to Jo showed a significantly lower proportion of unclassifiable cases (8–10% vs 49–52%; $p < 0.001$). The highest rate of unclassifiable cases in Masada's system was found for those types that mainly resembled Jo Types IVa. However, Jo's system was also unable to capture the entire range of existing tumour locations.

Treatment-oriented algorithms depend on a precise description of the pathology. For example,

several studies have attempted to determine which factors may be responsible for RH dislocation and poorer outcomes. In our opinion, it may be important for the further clinical course to know whether there are any other osteochondromas besides the main ones described in the different Masada types. The classification of Jo et al. (2017) showed better but only moderate reliability among the experts. Although an excellent agreement overall could not be obtained with either classification, Jo's system enabled the raters to adequately classify more cases, especially those with both distal radius *and* ulna osteochondromas. Therefore, we suggest that the system of Jo et al. (2017) should be preferred until a more reliable grading system has been developed.

Acknowledgements European Paediatric Orthopaedic Society (EPOS) Upper Limb Study Group members are: Eva Pontén, Andrea Jester, Christina Steiger, Nunzio Catena, Francisco Soldado, Giovanni Luigi Di Gennaro, Sergio Martínez-Alvarez, and Sebastian Farr. The authors would like to thank the following collaborators for participation in this study: Rudolf Ganger, Florian Schachinger, Alexandra Stauffer, Marcos Fernandes Carvalho, Ignacio Sanpera, Ismat Ghanem and John Ham.

Declaration of conflicting interests The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Sebastian Farr, MD, reports consulting fees from Orthofix Srl (Bussolengo, Italy) outside the submitted work. All other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The Open Access funding was provided by the Medical University Vienna.

References

Belyea C, Pulos N, Ezaki M et al. Effect of distal ulna osteochondroma excision and distal ulnar tether release on forearm deformity in preadolescent patients with multiple hereditary exostosis. J Pediatr Orthop. 2020, 40: e222–6.

Ham J, Flipsen M, Koolen M, van der Zwan A, Mader K. Multiple osteochondromas (MO) in the forearm: a 12-year single-centre experience. Strategies Trauma Limb Reconstr. 2016, 11: 169–75.

Jo AR, Jung ST, Kim MS, Oh CS, Min BJ. An evaluation of forearm deformities in hereditary multiple exostoses: factors associated with radial head dislocation and comprehensive classification. J Hand Surg Am. 2017, 42: 292.e1–8.

Masada K, Tsuyuguchi Y, Kawai H, Kawabata H, Noguchi K, Ono K. Operations for forearm deformity caused by multiple osteochondromas. J Bone Joint Surg Br. 1989, 71: 24–9.

Sebastian Farr[1]*, Arnard L van der Zwan[2], Erik Kommol[3] and EPOS Upper Limb Study Group and Collaborators

[1]Department of Pediatric Orthopaedics and Foot and Ankle Surgery, Orthopaedic Hospital Speising, Vienna, Austria
[2]OLVG Amsterdam, Amsterdam, The Netherlands
[3]Praterstrasse, Vienna, Austria
*Corresponding author: sebastian.farr@oss.at

doi: 10.1177/1753193420954356 available online at http://jhs.sagepub.com

Outcomes of mini-open carpal tunnel release for severe carpal tunnel syndrome: a 10-year follow-up

Dear Editor,

The current standard of care for patients who have failed conservative management of carpal tunnel syndrome (CTS) remains mini-open carpal tunnel release (OCTR). This is supported by a recent Cochrane review of 33 studies, which demonstrated there was no strong evidence to replace OCTR with endoscopic alternatives (Scholten et al., 2007). Specifically, the mini-open technique entails a 1.5–3 cm incision at the intersection point of Kaplan's cardinal line and the proximal extension of the radial border of the ring finger, a smaller incision than the modified or traditional open approaches. There is, however, a relative paucity of data available with reference to the long-term results of OCTR, especially for severe cases. Several studies describe symptom recurrence as high as 50% after medium-term follow-up, as well as the emergence of late surgical complications, such as scar tenderness or deep wrist ache (Nancollas et al., 1995). Furthermore, many articles pertaining to this topic have not used validated outcome measures.

We report the outcomes of 92 hands with severe CTS, a mean of 10.7 years after OCTR, using the Boston carpal tunnel questionnaire (BCTQ) score as a validated measure of symptoms and function. The BCTQ score was completed independently with reference to the operated side. We also performed subgroup analysis to ascertain the effect of age (above or below 55), gender, diabetes, smoking and preoperative symptoms on long-term outcomes. Patients were subsequently contacted by telephone interview to evaluate overall satisfaction, subjective improvement of symptoms and reoperation rates.