Published in final edited form as:

Plast Reconstr Surg. 2013 September ; 132(3): 597–603. doi:10.1097/PRS.0b013e31829ad1c1.

The Effect of Swan-neck and Boutonniere Deformities on the Outcome of Silicone Metacarpophalangeal Joint Arthroplasty in Rheumatoid Arthritis

Matthew Chetta, MD¹, Patricia B. Burns, MPH², H. Myra Kim, ScD³, Frank D. Burke, MD⁴, E. F. Shaw Wilgis, MD⁵, David A. Fox, MD⁶, and Kevin C. Chung, MD, MS⁷

¹House Officer, Section of Plastic Surgery, Department of Surgery, University of Michigan Health System

²Research Associate, Section of Plastic Surgery, Department of Surgery, University of Michigan Health System

³Associate Research Scientist, Center for Statistical Consultation and Research, University of Michigan

⁴Professor of Hand Surgery, Pulvertaft Hand Centre

⁵Director of Research, Curtis National Hand Center

⁶Professor of Internal Medicine, Department of Internal Medicine, Division of Rheumatology, University of Michigan Health System

⁷Professor of Surgery, Section of Plastic Surgery, Department of Surgery, University of Michigan Health System

Abstract

Purpose—Rheumatoid arthritis patients with swan-neck deformities (SND) are postulated to have greater metacarpophalangeal (MCP) joint arc of motion (AOM) because of their need to flex the MCP joint to make a fist. Whereas the boutonniere deformity (BD) places the fingers into the flexed position creating less demand on the MCP joint for grip. This study analyzes the effect of these deformities on MCP joint AOM and hand function.

Methods—We measured the MCP joint AOM in 73 surgical patients. These data were allocated into groups by finger and hand deformity. We used linear regression models to analyze the effect of the finger deformity on the MCP joint AOM. Functional outcomes were measured by the Michigan Hand Outcomes Questionnaire (MHQ) and the Jebson-Taylor test (JTT).

Results—Nineteen fingers were categorized with BD, 95 fingers with SND, and 178 fingers with no deformity. The non-deformity group had the least AOM at baseline (16°) compared to the BD (26°) and SND (26°) groups. The mean AOM in the non-deformity group compared to the BD group at baseline was statistically significant but all groups had similar MCP joint AOM at long

Corresponding author: Kevin C. Chung, MD, MS, Section of Plastic Surgery, The University of Michigan Health System, 1500 E. Medical Center Drive, 2130 Taubman Center, SPC 5340, Ann Arbor, MI 48109-5340.

Commercial Associations and Financial Disclosures: None to report

term follow-up. Mean MHQ and JTT scores were not significantly different amongst groups with the exception of JTT scores at baseline between BD and non-deformity.

Discussion—Our results did not support the hypothesis that patients with SND have better AOM compared to patients with BD. Patients with BD have worse function at baseline but there was no difference in function amongst groups at long-term follow-up.

Keywords

Boutonniere deformity; Rheumatoid arthritis; Swan-neck deformity

Rheumatoid arthritis (RA) is a polyarticular disease with progressive joint destruction leading to chronic pain and disability. Involvement of the metacarpophalangeal (MCP) joint is characterized by flexion, palmar subluxation, and ulnar deviation. Silicone metacarpophalangeal joint arthroplasty (SMPA) is a common procedure with the primary goal to improve hand function and relieve chronic pain.(1–3) When contemplating SMPA, multiple issues must be considered. Hand biomechanics are extremely complex and outcomes following multiple joint SMPA are difficult to assess. It is challenging to evaluate each joint in isolation because there is substantial interplay between adjacent joints in the hand. Evaluation of surrounding joints is necessary prior to planning SMPA and should include careful examination of the proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints. Two of the more common deformities in RA involving these joints are the swan-neck and boutonniere deformities. Nalebuff described the boutonniere deformity as having a detrimental effect on MCP joint arc of motion and recommended correction prior to SMPA.(4) This belief stems from the observation that RA patients with boutonniere deformity are capable of making a fist because of the flexed posture of the PIP joint at rest placing less demand for flexion at the MCP joint. In contrast, PIP joint hyperextension in the swan-neck deformity creates greater need for MCP joint motion to make a fist. Therefore, Nalebuff recommends delaying the treatment of swan-neck deformity for a later stage after SMPA.

In theory, this increased arc of motion at the MCP joint in patients with swan-neck deformity could improve outcomes following SMPA that may lead to better hand function as this group may achieve greater motion following surgery. However, this effect and whether increasing MCP joint motion is correlated with improved hand function has not been demonstrated in this population. In the era of evidence-based medicine, we have the unique opportunity to test this hypothesis by analyzing data from a large cohort of SMPA patients in the Silicone Arthroplasty in Rheumatoid Arthritis (SARA) trial. These data allow us to evaluate whether finger deformities affect MCP joint arc of motion following SMPA and may guide future treatment algorithms in this complex disease process.

The purpose of this study is to determine whether patients with swan-neck deformity have increased arc of motion at the MCP joint compared to patients with no fixed deformity or boutonniere deformity. Additionally, we evaluated whether increased arc of motion at the MCP joint impacted outcomes following surgery. We hypothesized that greater arc of motion at the MCP joint translates into improved hand function and patient-reported outcomes following SMPA.

MATERIALS AND METHODS

Patient Sample

We collected data from this patient sample as part of a multi-center international study of SMPA amongst RA patients with severe hand deformities.⁽⁵⁾ Subjects diagnosed with RA were referred by their rheumatologists to hand surgeons at one of the three study sites (University of Michigan (Ann Arbor, MI), Curtis National Hand Center (Baltimore, MD) and Pulvertaft Hand Centre (Derby, England)). All of the study sites received institutional review board approval prior to recruitment of subjects. Study coordinators obtained signed informed consent forms for all those enrolled in the study. Subjects were required to have severe deformities at the MCP joint to be enrolled. Severe deformity was defined as the sum of the average ulnar deviation and average extensor lag of the four fingers being $\geq 50^\circ$. Eligibility criteria for the study also included being 18 years of age or older and having the ability to complete questionnaires in English. Subjects were excluded with health problems that prohibited surgery, extensor tendon ruptures in the study hand, previous MCP joint replacement, or the initiation of disease-modifying antirheumatic drugs (DMARDs) within three months of enrollment. Boutonniere or swan-neck deformities were not treated surgically at any time in this cohort of subjects. This was a prospective cohort study that was non-randomized due to strong patient preference. Subjects were able to choose whether to have surgery or not and which hand would undergo surgery. Subjects were then followed at specific intervals including baseline, 12, and 24 months after surgery. The dataset for this analysis was restricted to surgical subjects.

Measures

Study assessments included arc of motion measurements for the joints in the hands and wrist measured by a certified hand therapist, the Michigan Health Questionnaire (MHQ), and the Jebsen-Taylor test (JTT). Photographs were obtained at baseline and at 24 months. X-rays were obtained at baseline. Review of the photographs and x-rays of each finger allowed categorization of each finger into three groups: boutonniere deformity, swan-neck deformity, and no deformity.

We chose the MHQ as our primary outcome measure.^(6–7) This is a 37-item hand-specific psychometric outcome questionnaire that assesses the patient's global hand function and includes six domains: (1) overall hand function, (2) activities of daily living (ADL), (3) pain, (4) work performance, (5) aesthetics, and (6) patient satisfaction. Each domain, with the exception of pain, is scored on a scale from 0 (poor performance) to 100 (best performance). Higher scores for pain indicate worse pain. The MHQ is unique in that it adjusts for hand dominance and is able to distinguish disabilities between both hands.

We used the JTT⁽⁸⁾ as an additional measure of hand function as it simulates common activities and includes several functional tests: (1) writing a short sentence, (2) turning over 3×5 inch cards, (3) picking up small objects and placing them in a container, (4) stacking checkers, (5) simulated eating, (6) moving large, empty cans, and (7) moving large, weighted cans. The time required to complete each task is recorded in seconds. The writing component was not assessed in this study because writing is highly dependent on hand

dominance and these results are difficult to interpret. This test has been shown to be both reliable and valid and has been shown particularly useful in discriminating different levels of rheumatoid hand impairment.⁽⁹⁾ A higher JTT score indicates worse outcomes.

Data analysis

Depending on the objective, analyses were done in two ways: using finger as the unit of analysis and hand as the unit of analysis. We assessed the relationship between finger deformity type and individual MCP joint arc of motion by classifying each finger into three categories based on finger deformity: (1) no deformity, (2) boutonniere deformity, and (3) swan-neck deformity. We used mixed-effects models to evaluate how baseline MCP joint arc of motion at each assessment time differs by the three finger deformity types. We included random effects for patients to adjust for variation between patients in finger AOM. We used fixed effects for the three finger deformity types by including an indicator for swan-neck deformity and an indicator for no deformity, with boutonniere deformity as reference. Furthermore, we evaluated the finger deformity's effect on MCP joint arc changes at 12 months and 24 months for improvement comparisons by finger deformity types. All models were adjusted finger location, and the 12 and 24 months models were also adjusted for baseline arc of motion.

We also assessed the impact of these finger deformities on overall hand function following surgery by classifying individual hand into three groups based on the pre-surgery finger deformities: (1) hands with no finger deformity, (2) hands with one or more boutonniere deformity, but no swan-neck deformity, and (3) hands with one or more swan-neck deformity, but no boutonniere deformity. We had a category for hands with mixed deformity (both boutonniere deformity and swan-neck deformity), but because of the small number of subjects affected by both deformities and also to decrease potential confounders, we excluded this group from the analysis. To determine the impact of these fixed flexion deformities on long-term functional outcomes, we fit separate regression models for each hand outcomes assessment (as measured by the MHQ and JTT) at 12 and 24 months as changes from baseline. Baseline values of the outcome variable were included in the model for adjustment. Prior to analysis we determined that with 80% power to detect a significant difference of 20 degrees between groups, we would need a sample size of 11 in each group. All analyses were done using Stata 12.0 (StataCorp, College Station, TX). Statistical significance was set at 0.05.

RESULTS

The study included 73 surgical subjects. Three of 73 subjects were excluded from the analysis of hand outcomes due to having mixed deformities. At baseline, the mean age of our sample was 60 with a range of 36–77 and the majority of subjects were female (N=57, 78%) and white (N=60, 95%), had less than 4 years of college education (N=52, 78%), and incomes greater than or equal to \$30,000 per year (N=26, 45%).

Finger Arc of Motion by Finger Deformity

The number of fingers and the mean MCP joint arc of motion for each deformity group are shown in Table 1 and Figure 1. The mean arc of motion at the MCP joint ranges from 26 to 35 at twenty-four months post-operatively. These averages are consistent with several previously published series.^(10–17) The number of fingers with boutonniere deformity is small in comparison to the other groups. The no deformity group has the lowest mean MCP joint arc at baseline. Unadjusted cross-sectional means show some improvement in MCP joint arc at 12 and 24 months after surgery in all three finger deformity types. The no deformity group shows the greatest improvement (range 13–16°) and less improvement for boutonniere and swan-neck deformity groups (range 2–9°). Further investigation of MCP arc by deformity using the mixed-effects model (Table 2) showed that at baseline, after adjusting for finger location, fingers with either boutonniere deformity or swan-neck deformity had significantly better arc of motion compared to fingers with no deformity ($p = 0.003$, based on testing for the difference in the corresponding coefficients). In terms of change in MCP joint arc from baseline at 12 months or 24 months, no differences were seen between fingers with no deformity vs. fingers with boutonniere deformity, or between fingers with swan-neck deformity vs. fingers with boutonniere deformity.

Hand Outcomes Analysis

We evaluated functional outcomes based on MHQ and JTT scores by the hand deformity groups (no deformity, boutonniere deformity and swan-neck deformity). Initially, we compared the mean MHQ and JTT scores for the three groups (Table 3). Similar to the results in Table 1, the number of hands with boutonniere deformity was small in comparison to the other groups. Mean MHQ scores were similar at baseline for all groups and improved likewise at 12 and 24 months. Crude mean JTT scores were higher (indicating for worse function) for the boutonniere deformity group at baseline but at 12 and 24 months all groups had similar mean scores. After adjusting for baseline values of the outcome variable, we found no differences in MHQ scores at all time periods across the different hand deformity groups (Table 4). The analysis of baseline JTT scores shows that subjects with no deformity have higher function than subjects with boutonniere deformity (Table 4). At 12 and 24 months after SMPA, no differences in JTT scores were found across the three hand deformity groups.

DISCUSSION

The results from our analysis did not support the hypothesis that RA patients with swan-neck deformity have a greater arc of motion before or after surgery at the MCP joint. Overall, we found that fingers with boutonniere and swan-neck deformities have higher MCP joint arcs at baseline. The no deformity group had the lowest motion arc pre-operatively, though no significant difference was seen post-operatively across the three groups. Our data showing that patients with no deformity had the lowest motion arc may be attributed to their ability to compensate mechanically at the PIP and DIP joints and not require as much motion at the MCP joint, thereby yielding a decreased motion arc. This study supports the tradition of reconstruction beginning proximal and that SMPA should be performed prior to treatment of swan-neck or boutonniere deformities.

A secondary hypothesis was that greater arc of motion would correlate with improved hand function and outcomes following surgery. Our results did not confirm this hypothesis. The absolute motion arc at the MCP joint after SMPA may not be as important as the actual position of the arc. SMPA has previously been demonstrated to move the arc from a flexed position to a more extended position following SMPA.(18) The only results in the functional analysis that were statistically significant were the higher mean JTT scores (worse function) for the boutonniere deformity group at baseline compared to the no deformity group. Patients with boutonniere deformity may have more difficulty with dexterity to manipulate objects because of the limited extension of the proximal interphalangeal (PIP) joints. But after SMPA, the extended arc at the MCP joint enhances boutonniere deformity patients in performing the JTT. The no deformity group had the lowest arc of motion at baseline but had better function as assessed through the JTT at the same time period. It is quite possible that the more mobile PIP joints in the no deformity group make performing the JTT much easier.

There are several limitations in our study. First, because of the method of categorization involved evaluating photos and radiographs, the grade of the deformity and whether the finger may be passively extended was not assessed. Further, our assessment of hand function takes into account those hands affected by finger deformities, but not the degree or laterality of involvement. For example, hands with only a single finger involved may have different functional impairment compared to hands with multiple fingers affected. Furthermore, hands affected by ulnar digits may have different impairment than hands affected by radial digits.

Despite these limitations, our results contradict the belief that boutonniere deformity has deleterious effects on MCP joint arc of motion. Nalebuff's theory on treating boutonniere deformity prior to SMPA to improve outcomes is elegant in concept but was not supported by this study. Traditionally, hand reconstruction begins proximally and works distally. Our analysis did not support the need to deviate from this practice for boutonniere deformity. Our findings are influenced by the unique pathology surrounding boutonniere deformity in contrast to swan-neck deformity. Synovitis leading to boutonniere deformity is isolated to the PIP joint whereas swan-neck deformity may be caused by disorders at the wrist, MCP joint, PIP joint, or DIP joint.(19–20) However, care must be individualized. Some patients may benefit from having a fixed flexion deformity corrected prior to SMPA, for example, if the post-operative recovery from SMPA would cause worsening of the deformity from immobilization. This project highlights the need for further studies to examine long-held beliefs in rheumatoid hand surgery.

Acknowledgments

Research reported in this publication was supported by the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Number (2R01AR047328 - 06) and a Midcareer Investigator Award in Patient-Oriented Research (K24 AR053120) (to Dr. Kevin C. Chung). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The authors acknowledge the assistance of the following participants of the SARA Study Group: Sandra V. Kotsis, MPH, (University of Michigan), Lorraine A. Zellers, CRC (Curtis National Hand Center), Marian Regan, MD, Mary J. Bradley, MSc, Melanie Arundell (Pulvertaft Hand Centre) and the referring rheumatologists in Michigan, Derby and Baltimore. The authors also greatly appreciate the assistance of Jeanne M. Riggs, OTR, CHT, Kurt Hiser, OTR, Carole Dodge, OTR, CHT, Jennifer Stowers, OTR, CHT, Cheryl Showerman, OTR, Jo Holmes, OTR, Victoria Jansen, PT and Helen Dear, OTR in taking measurements for the study patients. Additionally, the

authors would like to acknowledge Research Associate Kate Wan-Chu Chang, MA, for her assistance in statistical analyses.

REFERENCES

1. Chung KC, Kotsis SV, Kim HM, Burke FD, Wilgis EFS. Reasons why rheumatoid arthritis patients seek surgical treatment for hand deformities. *J Hand Surg Am.* 2006; 31:289–294. [PubMed: 16473693]
2. Alderman AK, Arora AS, Kuhn L, Wei Y, Chung KC. An analysis of women's and men's surgical priorities and willingness to have rheumatoid hand surgery. *J Hand Surg Am.* 2006; 31:1447–1453. [PubMed: 17095372]
3. Mandl LA, Burke FD, Wilgis EFS, Lyman S, Katz JN, Chung KC. Could preoperative preferences and expectations influence surgical decision making? Rheumatoid arthritis patients contemplating metacarpophalangeal joint arthroplasty. *Plast Reconstr Surg.* 2008; 121:175–180. [PubMed: 18176218]
4. Nalebuff EA. The rheumatoid hand. Reflections on metacarpophalangeal arthroplasty. *Clin Orthop.* 1984; 182:150–159. [PubMed: 6692609]
5. Chung KC, Burns PB, Wilgis EFS, et al. A multicenter clinical trial in rheumatoid arthritis comparing silicone metacarpophalangeal joint arthroplasty with medical treatment. *J Hand Surg Am.* 2009; 34:815–823. [PubMed: 19410984]
6. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. *J Hand Surg Am.* 1998; 23:575–587. [PubMed: 9708370]
7. Chung KC, Hamill JB, Walters MR, Hayward RA. The Michigan Hand Outcomes Questionnaire (MHQ): assessment of responsiveness to clinical change. *Ann Plast Surg.* 1999; 42:619–622. [PubMed: 10382797]
8. Jebsen RH, Taylor N, Trieschmann RB, Trotter MJ, Howard LA. An objective and standardized test of hand function. *Arch Phys Med Rehabil.* 1969; 50:311–319. [PubMed: 5788487]
9. Sharma S, Schumacher HR Jr, McLellan AT. Evaluation of the Jebsen hand function test for use in patients with rheumatoid arthritis. *Arthritis Care Res.* 1994; 7:16–19. [PubMed: 7918721]
10. Mannerfelt L, Andersson K. Silastic arthroplasty of the metacarpophalangeal joints in rheumatoid arthritis. *J Bone Joint Surg Am.* 1975; 57:484–489. [PubMed: 1141257]
11. Vahvanen V, Viljakka T. Silicone rubber implant arthroplasty of the metacarpophalangeal joint in rheumatoid arthritis: a follow-up study of 32 patients. *J Hand Surg Am.* 1986; 11:333–339. [PubMed: 3711605]
12. Bieber EJ, Weiland AJ, Volenc-Dowling S. Silicone-rubber implant arthroplasty of the metacarpophalangeal joints for rheumatoid arthritis. *J Bone Joint Surg Am.* 1986; 68:206–209. [PubMed: 3944159]
13. Goldfarb CA, Stern PJ. Metacarpophalangeal joint arthroplasty in rheumatoid arthritis: a long-term assessment. *J Bone Joint Surg Am.* 2003; 85:1869–1878. [PubMed: 14563791]
14. Kirschenbaum D, Schneider LH, Adams DC, Cody RP. Arthroplasty of the metacarpophalangeal joints with use of silicone-rubber implants in patients who have rheumatoid arthritis. Long-term results. *J Bone Joint Surg Am.* 1993; 75:3–12. [PubMed: 8419388]
15. Parkkila T, Belt EA, Hakala M, Kautiainen H, Leppilahti J. Comparison of Swanson and Sutter metacarpophalangeal arthroplasties in patients with rheumatoid arthritis: a prospective and randomized trial. *J Hand Surg Am.* 2005; 30:1276–1281. [PubMed: 16344188]
16. Wilson YG, Sykes PJ, Niranjana NS. Long-term follow-up of Swanson's silastic arthroplasty of the metacarpophalangeal joints in rheumatoid arthritis. *J Hand Surg Br.* 1993; 18:81–91. [PubMed: 8382250]
17. Chung KC, Burns PB, Wilgis EF, Burke FD, Regan M, Kim MH, et al. A multicenter clinical trial in rheumatoid arthritis comparing silicone metacarpophalangeal joint arthroplasty with medical treatment. *J Hand Surg Am.* 2009; 34:815–823. [PubMed: 19410984]
18. Chung KC, Kotsis SV, Wilgis EF, Fox DA, Regan M, Kim HM, Burke FD. Outcomes of silicone arthroplasty for rheumatoid metacarpophalangeal joints stratified by fingers. *J Hand Surg Am.* 2009; 34:1647–1652. [PubMed: 19896008]

19. Harrison SH. Rheumatoid deformities of the proximal interphalangeal joints of the hand. *Ann Rheum Dis.* 1969; 28(Suppl):20–22. [PubMed: 5379844]
20. Harrison SH. The proximal interphalangeal joint in rheumatoid arthritis. *Hand.* 1971; 3:125–130. [PubMed: 5127918]

Figure 1.

Mean arc of motion for deformity groups*

Abbreviations: ND: No deformity, boutonniere deformity: Boutonniere deformity, swan-neck deformity: Swan-neck deformity

*Standard deviations for deformity groups:

ND baseline (15), 12 months (18), 24 months (21)

boutonniere deformity baseline (26), 12 months (15), 24 months (12)

swan-neck deformity baseline (22), 12 months (16), 24 months (19)

Table 1
Analysis by Finger: Mean Metacarpophalangeal Joint Arc of Motion by Finger Deformity at Baseline, and at 12 and 24 Months Following Silicone Metacarpophalangeal Joint Arthroplasty

	Baseline			12 months			24 months		
	73 subjects			54 subjects			52 subjects		
	N	Mean (SD)	Ext, Flex *	N	Mean (SD)	Ext, Flex	N	Mean (SD)	Ext, Flex
ND	178	16 (15)	(65, 81)	123	29 (18)	(28, 57)	104	32 (21)	(24, 56)
BD	19	26 (26)	(66, 92)	11	28 (15)	(31, 59)	9	34 (12)	(33, 67)
SND	95	26 (22)	(64, 90)	78	33 (16)	(29, 62)	63	35 (19)	(28, 63)

Abbreviation: ND is no deformity; BD is Boutonniere deformity; SND is Swan-neck deformity. N denotes number of fingers.

* Ext, Flex: Mean absolute extension lag, mean absolute flexion

Table 2

Analysis by Finger: The effect of finger deformities on metacarpophalangeal joint arc of motion at baseline after adjusting for finger location, and changes at 12 months and 24 months, after adjusting for finger location and baseline arc of motion.

	Baseline			12 months			24 months		
	Coefficient	95% CI*	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Boutonniere Deformity	Ref[^]	--	--	Ref	--	--	Ref	--	--
No Deformity	-11.56	-20.1, -3.0	0.008	-1.93	-9.5, 5.6	0.62	-5.42	-16.1, 5.3	0.32
Swan-neck Deformity	-3.91	-13.1, 5.3	0.404	0.46	-7.9, 8.8	0.91	-3.13	-14.7, 8.5	0.60

* CI is confidence interval;

[^] Ref is Reference value.

Note: The coefficients for the no deformity and swan-neck group are expected differences in arc of motion at each assessment time compared with the boutonniere deformity group. A number less than 0 indicates less overall arc of motion at the MCP joint and the value represents the magnitude of the difference.

Table 3

Analysis by Hand Deformity: Mean MHQ and JTT Scores at Baseline, 12, and 24 months following Silicone Metacarpophalangeal Joint Arthroplasty

		Baseline		12 months		24 months	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	
Michigan Hand Questionnaire							
ND	29	36 (16)	21	59 (19)	20	59 (19)	
BD	6	40 (23)	5	64 (23)	5	65 (25)	
SND	31	38 (20)	25	61 (25)	24	61 (23)	
Jebsen-Taylor Test							
ND	32	51 (17)	21	43 (16)	18	44 (12)	
BD	7	74 (47)	5	50 (22)	5	40 (9)	
SND	30	53 (28)	25	43 (14)	21	44 (12)	

Abbreviation: SD is standard deviation; ND is hands with no finger deformity; BD is hands with at least one finger with Boutonniere deformity, but no Swan-neck deformity; SND is hands with at least one finger Swan-neck deformity, but no Boutonniere deformity. N denotes the number of subjects.

Note: A higher MHQ score corresponds with increased function, and a lower JTT score corresponds with increased function.

Table 4

Analysis by Hand Deformity: The effect of hand deformities on MHQ and JTT Scores at Baseline and Changes at 12 and 24 Months.

	Baseline			12 months			24 months		
	Coefficient	95% CI [*]	p-value	Coefficient	95% CI	p-value	Coefficient	95% CI	p-value
Michigan Hand Questionnaire									
No Deformity	Ref [^]	--	--	Ref	--	--	Ref	--	--
Boutonniere Deformity	3.44	-12.8, 19.7	0.67	3.64	-14.1, 21.3	0.68	6.48	-10.3, 23.3	0.44
Swan-neck Deformity	1.89	-7.5 to 11.3	0.69	1.63	-8.9, 12.2	0.76	4.13	-6.1, 14.3	0.42
Jebson Taylor Test									
No Deformity	Ref	--	--	Ref	--	--	Ref	--	--
Boutonniere Deformity	22.42	1.2, 43.7	0.04	2.82	-9.2, 14.8	0.64	-6.92	-16.3, 2.4	0.14
Swan-neck Deformity	1.58	-11.4, 14.5	0.81	2.93	-4.3, 10.1	0.42	2.06	-3.9, 8.1	0.49

* CI is confidence interval;

[^] Ref is reference.

Note: A higher MHQ corresponds to better function and therefore a coefficient value greater than 0 translates as greater baseline function or improved function at 12 or 24 months compared with subjects with no deformity. A lower JTT score corresponds with better function and therefore a coefficient value less than 0 translates as better baseline function or improved function at 12 or 24 months.