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# Predicting Revision Following In Situ Ulnar Nerve Decompression for Patients With Idiopathic Cubital Tunnel Syndrome.

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1 **ABSTRACT**

2 PURPOSE

3 To determine the incidence of revision and potential risk factors for needing  
4 revision surgery following in situ ulnar nerve decompression for patients with  
5 idiopathic cubital tunnel syndrome (CuTS).

6

7 METHODS

8 We conducted a retrospective chart review of all patients treated at one specialty  
9 hand center with an open in situ ulnar nerve decompression for idiopathic CuTS  
10 from January 2006 through December 2010. Revision incidence was determined by  
11 identifying patients who underwent additional surgeries for recurrent or persistent  
12 ulnar nerve symptoms. Bivariate analysis was performed to determine which  
13 variables had a significant influence on the need for revision surgery.

14

15 RESULTS

16 Revision surgery was required in 3.2% (7 of 216) of all cases. Age of less than 50  
17 years at the time of index decompression was the lone significant predictor of need  
18 for revision surgery. Other patient factors, including sex, diabetes, smoking history,  
19 and worker compensation status were not predictive of the need for revision  
20 surgery. Disease-specific variables including nerve conduction velocities, McGowan  
21 grading, and predominant symptom type were also not predictive of revision.

22

23 CONCLUSIONS

24 For patients with idiopathic cubital tunnel syndrome, the risk of revision surgery  
25 following in situ ulnar nerve decompression is low. However, this risk was  
26 increased in patients who were younger than 50 years of age at the time of the index  
27 procedure. The findings of this study suggest that, in the absence of underlying  
28 elbow arthritis or prior elbow trauma, in situ ulnar nerve decompression is an  
29 effective, minimal-risk option for the initial surgical treatment of CuTS.

30

31 LEVEL OF EVIDENCE

32 Prognostic Level III

33

34 INTRODUCTION

35 Cubital tunnel syndrome (CuTS) is second only to carpal tunnel syndrome in  
36 incidence among compression neuropathies of the upper extremity. [1-3] Despite its  
37 commonality, there is no established consensus regarding the optimal surgical  
38 treatment. This is evidenced by a wide range of surgical options including in situ  
39 decompression, medial epicondylectomy and subcutaneous, intramuscular or  
40 submuscular transposition of the ulnar nerve. Additionally, in recent years surgeons  
41 have also advocated for endoscopic or minimal-incision release of the ulnar nerve,  
42 with or without transposition, to further minimize soft tissue trauma and potential  
43 vascular insult to the nerve, while allowing for faster recovery, thus further  
44 expanding the number of treatment options. [4-6]

45

46 Technique selection can depend on a variety of factors including surgeon  
47 preference, patient anatomy, patient desires, underlying pathology, and  
48 complication rates. Transposition, for example, often requires extensive dissection  
49 around the nerve, which may compromise its extrinsic vascular supply. Thus, it may  
50 be contraindicated in patients with diabetes for instance who may have a tenuous  
51 vascular system at the level of the cubital tunnel. [7, 8] In addition, with an  
52 increasing focus on healthcare economics in the United States, the relative cost-  
53 effectiveness of different treatment options for CuTS may progressively factor into  
54 surgical decision-making, thus potentially clouding the treatment decision even  
55 further. [9-11]

56

57 Generally, in situ decompression offers the least invasive surgical option but may  
58 increase the risk of revision surgery. [12, 13] A recent study found that prior history  
59 of trauma around the elbow was a notable predictor of need for revision after in situ  
60 decompression of the ulnar nerve, while other postulated factors including patient  
61 age had no effect. [14] However, risk factors for revision in patients with *idiopathic*  
62 CuTS, that is, those without an underlying traumatic, arthritic, or other pre-  
63 disposing etiology, remain unclear. As revision surgery yields inferior outcomes  
64 versus primary surgery for CuTS, information on risk factors leading to revision in  
65 these patients with idiopathic CuTS could provide a valuable addition to the overall  
66 treatment algorithm. [15]

67 The purpose of this study was to determine the incidence of needed revision after in  
68 situ ulnar nerve decompression for patients with idiopathic CuTS and to investigate  
69 which patient risk factor(s) may contribute to an increased likelihood of needing  
70 revision.

71

## 72 MATERIALS and METHODS

73 This study was approved by our institutional review board. Using our departmental  
74 electronic billing database search for Current Procedural Terminology (American  
75 Medical Association, Chicago, IL, USA) code 64718 (surgery on ulnar nerve at  
76 elbow), we identified all patients who had undergone in situ ulnar nerve  
77 decompression surgery from January 2006 through December 2010. Patients who

78 demonstrated intraoperative subluxation of the ulnar nerve following in situ  
79 decompression were excluded, as these patients subsequently underwent either  
80 anterior transposition of the ulnar nerve or medial epicondylectomy. Patients were  
81 also excluded if they underwent in situ ulnar nerve decompression for reasons other  
82 than treatment of CuTS symptoms (e.g., prophylactic release performed in  
83 conjunction with elbow arthroplasty or fracture fixation) or had previously  
84 undergone operative treatment for CuTS. In addition, patients with a prior history of  
85 fracture or trauma at the elbow were excluded, as were those with a history of  
86 degenerative, post-traumatic, or inflammatory arthritis at the elbow. However,  
87 patients with a known history of inflammatory or systemic arthritis without  
88 evidence of local arthritic changes at the surgical elbow were not excluded. Finally,  
89 patients with less than 6 months of follow-up at our institution were excluded from  
90 data analysis unless a revision surgery occurred in that time interval. Records for  
91 those patients with less than 6 months of follow-up were reviewed in an effort to  
92 predict their clinical course. In addition, attempts were made to contact those  
93 patients via telephone with the goal of identifying any patients that may have had  
94 additional surgery performed elsewhere.

95

#### 96 **Diagnostic workup**

97 Patients seen at our institution are generally evaluated by the treating surgeon prior  
98 to obtaining additional studies, including imaging or electrodiagnostic testing.  
99 Exceptions to this practice typically only occur in patients who are seen at our  
100 institution for a second opinion and have already undergone electrodiagnostic

101 testing prior to presentation. During initial evaluation, a comprehensive clinical  
102 examination, including disease-specific tests and provocative maneuvers, is  
103 performed. This includes 2 point-discrimination, vibratory discrimination testing,  
104 comparative grip strength testing, cross-finger testing, Froment sign, Tinel sign,  
105 elbow flexion-compression test, and testing for nerve mobility. When a patient is  
106 suspected of having CuTS based on clinical history and physical examination,  
107 standard elbow radiographs are routinely obtained to rule out contributory bony  
108 abnormalities or deformities in addition to electrodiagnostic testing. Nerve  
109 conduction tests are considered abnormal if conduction velocity across the affected  
110 elbow is less than 50 meters per second or is decreased by more than 10 meters per  
111 second across the elbow . The diagnosis of CuTS is based on clinical findings in  
112 conjunction with nerve testing results.

113

114 Additionally, effort is made to elucidate any nerve symptoms not originating at the  
115 elbow, such as proximally based cervical pathology or distal compression of the  
116 ulnar and median nerves at the wrist. When the diagnostic workup suggests  
117 pathology at those distal sites, it is not uncommon in our practice to perform  
118 concomitant release of the ulnar and median nerves at the Guyon canal and the  
119 carpal tunnel. However, for those patients with findings of ipsilateral cervical  
120 radiculopathy, the cervical pathology is generally addressed prior to any operative  
121 management of CuTS-related symptoms.

122

123 **Operative indications**

124 Indications for primary in situ decompression generally involve nerve symptoms  
125 consistent with CuTS that have failed a trial of conservative management, have  
126 positive electrodiagnostic findings, and have a stable ulnar nerve. At our institution,  
127 ulnar nerve hypermobility, manifested as nerve subluxation or dislocation during  
128 preoperative or intraoperative assessment, is considered a contraindication to  
129 performing in situ decompression alone. Thus, when such hypermobility is noted,  
130 alternative surgical options such as anterior ulnar nerve transposition or medial  
131 epicondylectomy are considered.

132

133 The decision to operate on patients with CuTS in the revision setting is a joint-  
134 agreement between the patient and surgeon. Although this is normally approached  
135 on a case-by-case basis, the typical scenario involves persistent or incomplete-  
136 resolution of symptoms compared to preoperatively. Workup for recurrent or  
137 persistent CuTS is largely the same as in primary CuTS described above.

138

### 139 **Surgical technique and postoperative protocol**

140 All surgeries were performed by one of 8, fellowship-trained orthopedic hand  
141 surgeons. A posteromedial incision measuring 5 to 10 centimeters centered about  
142 the epicondylar groove is used for exposure. As the incision is carried  
143 subcutaneously, care is taken to identify and protect branches of the medial  
144 antebrachial cutaneous nerve. Upon identification of the ulnar nerve,  
145 decompression is performed via surgical release of the Osborne ligament and fascia  
146 overlying the flexor carpi ulnaris with blunt dissection carried roughly 8



147 centimeters proximally to the level of the arcade of Struther. In those patients found  
148 to have an anconeus epitrochlearis, the anomalous muscle is generally split or  
149 excised depending on its involvement in compression of the ulnar nerve. Care is  
150 taken to avoid circumferential dissection around the nerve to preserve its vascular  
151 supply. Following release, the elbow is taken through its full range-of-motion to  
152 confirm stability of the ulnar nerve. Postoperatively, the limb is placed in a well-  
153 padded posterior long-arm orthosis with the elbow positioned in approximately 70  
154 degrees of flexion. Active range-of-motion is typically initiated subsequent to the  
155 first postoperative visit one week following surgery. Nerve conduction testing is not  
156 routinely performed postoperatively except in cases of persistent, recurrent, or  
157 worsening symptoms.

158

#### 159 **Data collection and statistical analysis**

160 For those patients satisfying inclusion in the study, demographic, medical, and  
161 surgical data were obtained from departmental records. We defined our primary  
162 outcome of interest to be revision cubital tunnel surgery performed after in situ  
163 ulnar nerve decompression. Thus any patients, who at the time of data analysis had  
164 not had revision surgery, were designated to the control cohort. Bivariate analysis  
165 was performed for categorical variables of sex, diabetes history, smoking history,  
166 presence of bilateral symptoms, predominant preoperative symptom, modified pre-  
167 and postoperative modified McGowan grade, concomitant surgery, and worker  
168 compensation status using Chi-square or Fisher exact testing. Continuous variables  
169 recorded preoperatively including symptom duration, body mass index (BMI), and

170 nerve conduction velocity (NCV), were compared using Student t-test or Mann-  
171 Whitney *U* test. Age was analyzed as both a categorical variable (less than 50 years  
172 versus greater-than-or-equal-to 50 years) and as a continuous variable.

173

## 174 RESULTS

175 A total of 216 elbows in 201 patients satisfied inclusion in this study. (See Figure 1)  
176 The mean age at the time of surgery for all 216 cases was 53 +/- 14 years, with  
177 mean follow-up duration of 22 +/- 21 months. Continuous and categorical  
178 demographic variables of the entire study cohort are represented in Tables 1 and 2,  
179 respectively.

180

181 Revision surgery was required in 7 (3.2%) cases, with the first revision occurring at  
182 a median interval of 10 months from the index surgery (range 3 to 59 months). Five  
183 of those patients were revised with anterior subcutaneous transposition, one with  
184 submuscular transposition, and one with intramuscular transposition. Two patients  
185 required more than one revision for persistent or recurrence of symptoms.

186 Treatment course and demographic characteristics of those patients requiring  
187 revision surgery are outlined in Table 3.

188

### 189 **Bivariate analysis**

190 Younger age had a statistically significant effect on need for revision surgery when  
191 analyzed as a continuous variable, mean age non-revised = 53 +/- 14 years versus  
192 revised = 43 +/- 7 years;  $P = 0.009$ , (see Table 1) and as a categorical variable (age  $\geq$

193 50 years vs. age < 50 years; Fisher exact test,  $P = 0.002$ , see [Table 2](#)). The duration of  
194 preoperative symptoms in the revised cohort was roughly double that of the  
195 controls, although this association only approached statistical significance ( $12 \pm$   
196  $11$  months versus  $26 \pm 17$  months;  $P = 0.08$ , [Table 1](#)). Patient sex, diabetes history,  
197 smoking history, predominant symptom at this time of surgery, modified McGowan  
198 grade, concomitant surgery, worker compensation status, body mass index, and  
199 ulnar nerve conduction velocity values were not statistically different between  
200 those patients requiring revision and those who did not. [Figure 2](#) illustrates the  
201 change in modified McGowan grade for the entire study cohort. [Tables 1 and 2](#) detail  
202 the respective relationships of continuous and categorical variables and the need for  
203 revision surgery.

204

### 205 **Subjective and validated outcomes**

206 No patients reported worsening of their symptoms following ulnar nerve in situ  
207 decompression compared to preoperatively. Of the 209 patients who did not  
208 undergo revision surgery, 3 patients complained of persistent sensory symptoms  
209 and were offered revision surgery, but they declined. A fourth patient reported  
210 recurrence of her symptoms and expressed desire to undergo revision surgery, but  
211 she was subsequently lost to follow-up. Multiple attempts to contact that patient via  
212 telephone were unsuccessful. The remaining 205 patients reported subjective  
213 improvement and general satisfaction following their operation. [Table 3](#) details the  
214 treatment course of the revision cohort.

215

216

217 DISCUSSION

218 Selecting the optimal surgical treatment plan for patients with idiopathic cubital  
219 tunnel syndrome remains a difficult task. Though numerous studies have explored  
220 differences in outcomes among the various surgical options, results have often been  
221 inconclusive, and at times, contradictory. [3, 16-18]

222

223 Need for revision surgery is a particularly important outcome to investigate, as it  
224 not only represents a sub-optimal clinical result but has important economic  
225 considerations as well. With a lack of high quality, adequately powered prospective  
226 randomized-control trials comparing the multitude of surgical options for CuTS,  
227 cost-effectiveness and decision analyses may afford clinicians a useful tool for  
228 comparisons when real-world studies fall short or may simply be impractical. [9, 11,  
229 19] A decision analysis study concluded that in situ decompression of the ulnar  
230 nerve had the highest utility of 4 tested surgical procedures, while medial  
231 epicondylectomy fared worst. [10] These results were later supported by Song et al,  
232 who explored the same four surgical treatments for CuTS and found that in situ  
233 decompression to be superior to the other options in cost-effectiveness. [11] Both  
234 studies used literature available at the time to account for expected incidences of  
235 complications and revision for each of the 4 surgical treatments examined. In a  
236 randomized-control trial comparing ulnar nerve in situ decompression with  
237 anterior subcutaneous transposition, Bartels et al found in situ decompression to be

238 superior from a cost perspective, while also demonstrating a lower incidence of  
239 complications. [3, 9]

240

241 Despite the findings of these studies supporting in situ decompression as a first-  
242 option for CuTS, the question remains as to which patients are best suited for this  
243 versus other surgical options for CuTS, particularly in regards to circumventing the  
244 need for revision surgery. Determining which patients are most likely to need  
245 revision surgery after initial decompression could be equally as valuable as the  
246 previously mentioned cost and decision-based analyses in avoiding the medical and  
247 economic costs associated with a second surgery. Krogue and colleagues studied  
248 factors leading to revision after in situ ulnar nerve decompression for CuTS and  
249 found that a prior history of elbow trauma was the most notable variable predicting  
250 the need for revision surgery after simple decompression. [14] In light of those  
251 findings, we determined that further investigation into risk factors leading to  
252 revision for patients with idiopathic would provide additional information to  
253 surgeons contemplating surgical options for CuTS.

254

255 In this study, we report an overall revision incidence of 3.2%, which is lower than  
256 previous studies of in situ decompression. At least one potential factor for this  
257 difference is the exclusion of patients with traumatic or arthritic etiology. However,  
258 this is not completely unlike a previous study by Goldfarb et al, who excluded  
259 patients with elbow arthritis, medial epicondylitis, and ulnar nerve subluxation, and

260 reported a revision incidence of 7%. [12] When Kroguet al implemented even less  
261 stringent inclusion criteria, they reported a revision incidence of 19%. [14] Taken  
262 together, these 3 studies suggest that, in the absence of both traumatic and arthritic  
263 conditions, simple in situ decompression of the ulnar nerve for CuTS has a low  
264 incidence of revision. A comparative overview of these studies is included in  
265 [Table 4](#).

266

267 Our study also provides statistically significant evidence that younger age is a risk  
268 factor for needing revision surgery in these patients. Although the clinical meaning  
269 of this finding is less clear, the relationship of younger age as a pre-disposing factor  
270 to complications after in situ decompression is not novel. Murata et al demonstrated  
271 younger age to be predictive of increased incidence of ulnar nerve dislocation, as  
272 simulated intra-operatively by placing patients' elbows in full-flexion after ulnar  
273 nerve decompression. [20] They suggested that anatomical differences in the size of  
274 the medial epicondyle and the shape of the ulnar groove played a role in the higher  
275 nerve dislocation incidence in younger patients. All elbows in our study were  
276 confirmed to have a ulnar nerve that neither subluxed or dislocated when tested  
277 intra-operatively after release had been performed during the index procedure.  
278 However, of the 7 cases requiring revision, 4 were noted to have a subluxating ulnar  
279 nerve at the time of revision surgery. None of these 4 patients was noted to have  
280 nerve instability in their latest physical examination prior to undergoing revision. It  
281 remains unclear as to the mechanism by which a confirmed stable ulnar nerve

282 would later become unstable without any further intervention. In addition, we were  
283 unable to account for the fact that these nerves appeared stable during examination  
284 and only after surgical re-exposure were they unstable. We speculate that perhaps  
285 some of the soft tissue and scarring that was released to gain exposure at the time of  
286 revision surgery may have also had a tethering effect on the nerve. Regardless of the  
287 means through which younger age predicts a higher revision incidence following in  
288 situ decompression for treatment of CuTS, these findings suggest a consideration for  
289 surgeons to discuss with younger patients seeking operative treatment for CuTS.

290

291 This study has limitations. Its retrospective nature required that we rely strictly on  
292 medical records, which were not always complete and could be subject to  
293 interpretation. In addition, though we only included patients who had at least 6  
294 months of follow-up at our institution, there is potential for bias if any patients  
295 sought care involving revision surgery elsewhere after that initial period. We sought  
296 to minimize this possibility by attempting to reach patients via telephone while also  
297 reviewing records for those patients to predict which, if any, would be likely to seek  
298 care elsewhere. We were unable to contact over one-third of those patients with less  
299 than 6 months of follow-up (see [Figure 1](#)). Furthermore, relying solely on clinical  
300 documentation to speculate on this type of information is imperfect. Lastly, while  
301 our specific aim was to investigate risk factors specific to idiopathic CuTS, exclusion  
302 of patients with post-traumatic or arthritic etiologies may have led to us to  
303 underestimate a clinically relevant revision incidence.

304

305 Despite these limitations, our results may be useful in establishing a treatment  
306 algorithm for uncomplicated idiopathic CuTS. In particular, for patients confirmed  
307 to have CuTS without arthritis or history of trauma to the involved elbow, our  
308 findings strongly support in situ decompression as a reliable, first-line surgical  
309 treatment option. The risk of revision increased somewhat in patients younger than  
310 50 years of age, though the underlying mechanism of this relationship remains  
311 unclear.

312



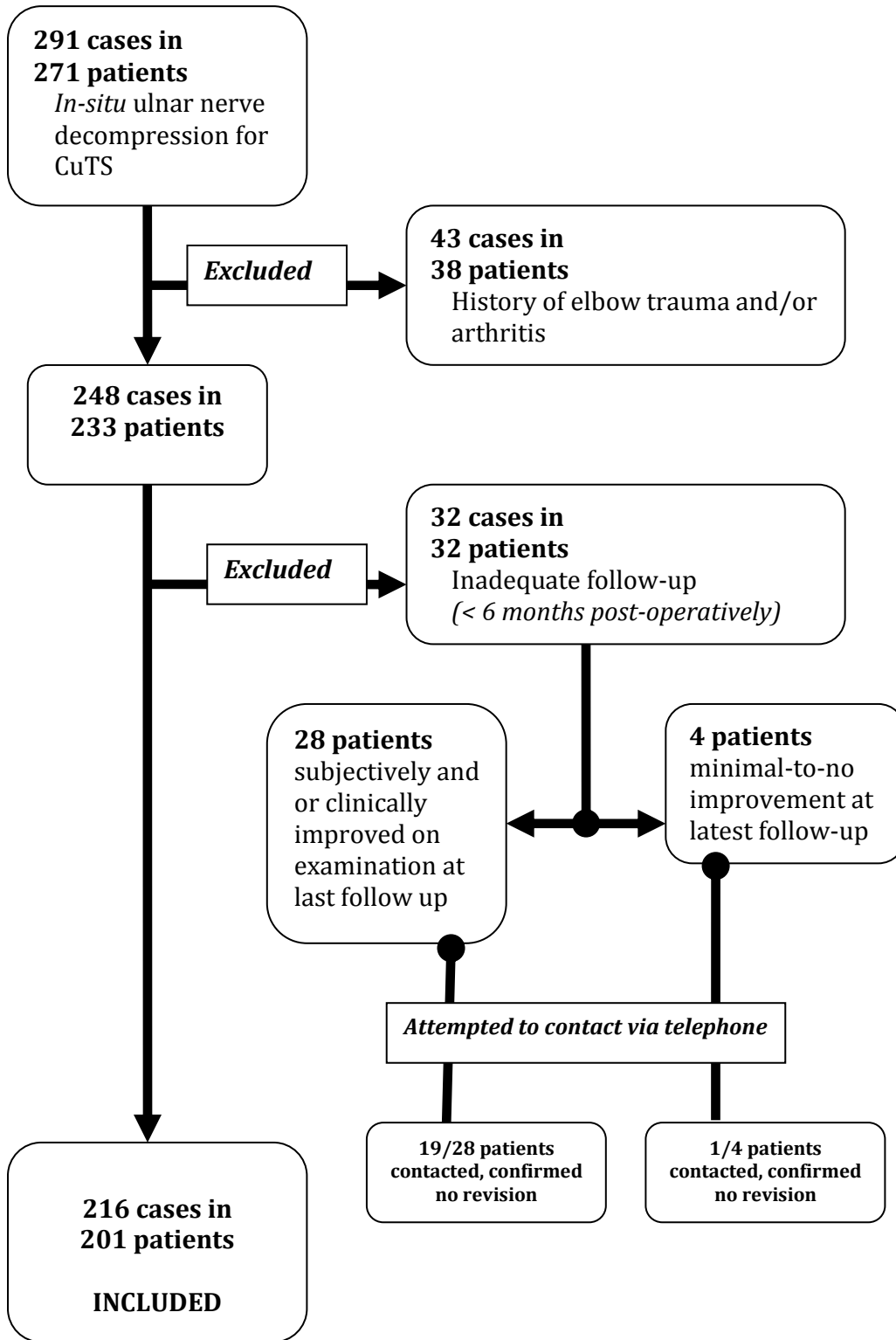
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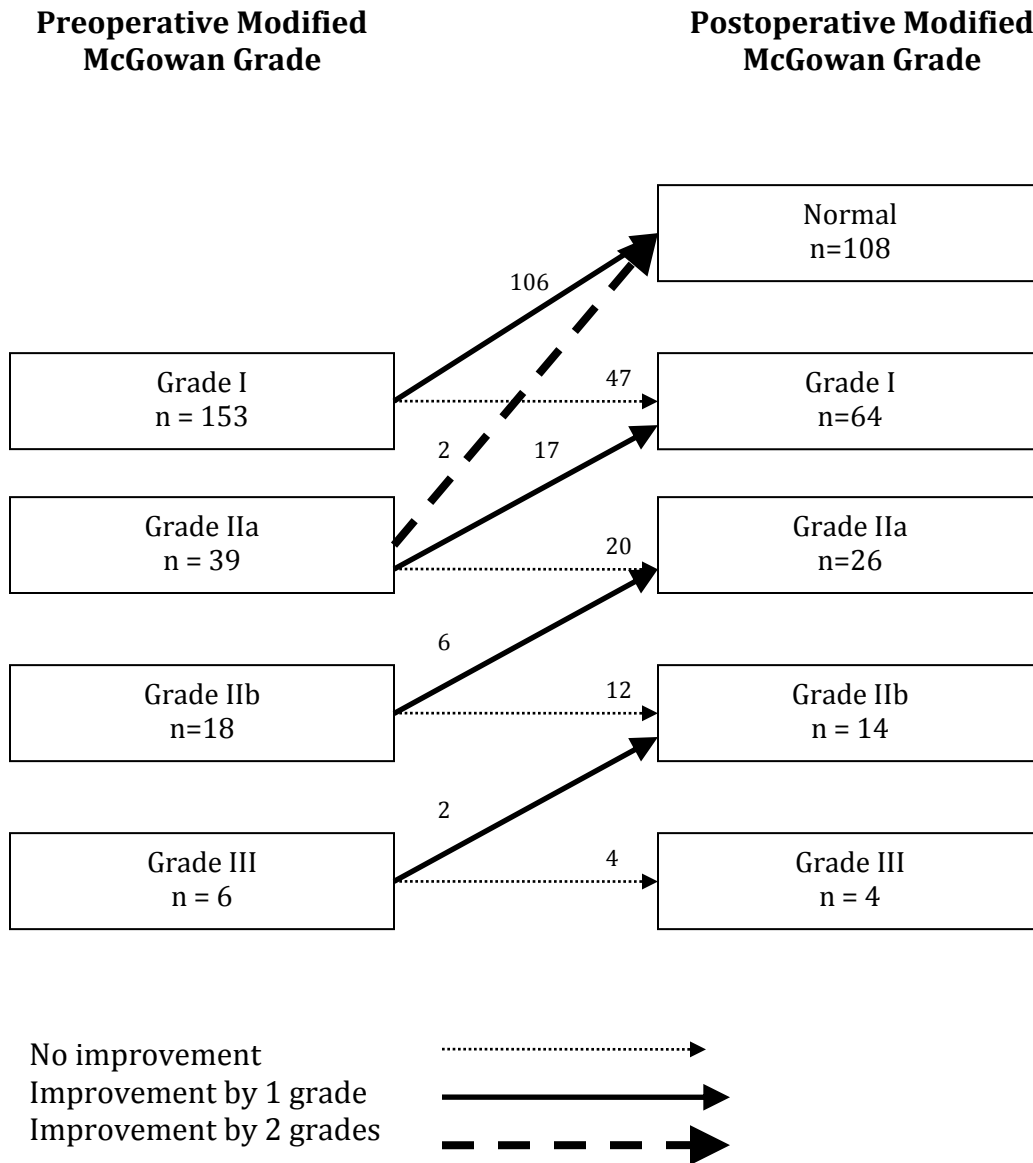
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- 370

371 **FIGURES**  
 372 **Figure 1.** Flow chart of inclusion and exclusion criteria applied to potential study  
 373 subjects.  
 374



375

376 **Figure 2.** Graphical representation of change between pre- to postoperative  
 377 Modified McGowan grade. Aside from 2 patients with preoperative grade of IIa who  
 378 improved to normal postoperatively (thick dashed arrow), all other patients either  
 379 improved by one grade (solid arrow) or remained the same (dotted arrow).



380