Continuing Trend of Increased Operative Treatment of Clavicle Fractures in Adolescents Despite Lack of Evidence in the Literature

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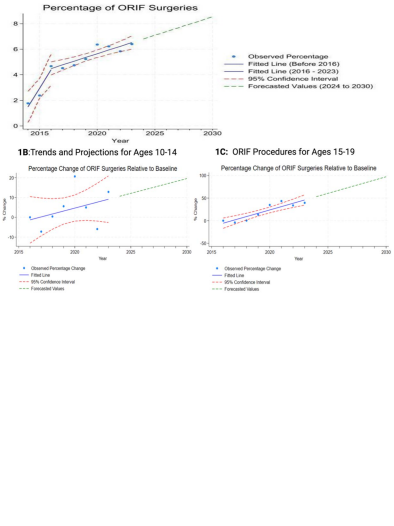
INTRODUCTION:
Pediatric clavicle fractures are among the most common fractures in this age group. Current research supports the efficacy of nonoperative treatment for these injuries in pediatric patients. Despite this, former studies have noted a rising trend in the surgical management of pediatric clavicle fractures. Our study seeks to examine the current trends in the management of these fractures and determine whether they align with the existing evidence-based guidelines.
METHODS:
A retrospective analysis of pediatric patients with clavicle between January 1st 2015 and December 31st 2023 were analyzed. This query was run in a large national database of healthcare organizations across the United States. Patients were dichotomized into two groups based on open reduction internal fixation (ORIF, CPT code 23515) and closed treatments (CPT codes 23500 and 23505) over this period, performing subgroup analyses by sex, ethnicity, race, and age, and employed regression models to predict future incidences. Our statistical analysis involved calculating the annual percentages of ORIF procedures across various demographics, conducting chi-squared and temporal trend analyses using Joinpoint regression to determine the Annual Percent Change (APC) in treatment modalities from 2014 to 2023. Future trends up to 2030 were forecasted using existing models, with all analyses conducted using Joinpoint software (Version 5) and Stata (Version 18.0). A literature review from 2008 to 2024 was performed to assess literature recommendations.
RESULTS:
74,945 patients aged 10-19 with clavicle fractures from 2014-2023 were assessed; 3,514 underwent ORIF. The ORIF rate increased from 1.8% in 2014 to 6.4% in 2023 (a 256% rise) and is projected to reach 8.5% by 2030 (a 32% increase), as shown in Table 1. A significant shift in ORIF procedure trends was identified in 2016 (Figure 1A), which was used to calculate the APC in categories. Males were more likely to receive ORIF procedures than females until 2020, when females showed a sharper yearly increase in ORIF procedures (APC of 8.3 vs 4.5, $P = 0.008$).The incidence of older adolescent patients (15-19 years age group) receiving ORIF increased by 50% from 2016 to 2023, while younger adolescent (10-14 years age group) had a lower rate of increase ($p < 0.001$ In 2014, 3.6% of older adolescents underwent ORIF procedures compared to 0.8% of younger adolescents. By 2023, these figures had increased to 11.7% and 3.2%, respectively. White patients consistently had a higher percentage of ORIF procedures compared to African American patients ($P<0.05$). However, the gap is closing, with African American patients showing a more significant percentage increase (APC of 8.8% vs 3.9%, $P=0.002$). Non-Hispanic patients underwent more ORIF procedures than Hispanic patients ($P<0.05$). Between 2008 and 2024, nine papers have been published that provide Level 4 evidence or higher regarding the treatment of fractures in adolescents. Of these, 81% recommend non-operative treatment, while one paper reported flexible intramedullar nail to be superior to nonoperative intervention. Additionally, multiple review articles have supported nonoperative approaches for pediatric clavicle fractures.
DISCUSSION AND CONCLUSION: Despite the lack of supporting literature, current trends in 2024 show an overwhelming rise in the surgical management of pediatric clavicle fractures (256%). This increase in ORIF procedures adds unnecessary risks to patients, such as infection, anesthesia complications, and prolonged recovery times, without clear benefits. Additionally, the financial burden is significant, elevating costs for patients and increasing the utilization of Medicare resources. This trend contradicts established evidence and imposes unnecessary health and economic burdens.

Table 1: Annual percentage of ORIF surgeries in total population and each demographic category. Each cell shows the percentage followed by the number of ORIF procedures and total procedures in parentheses.

Year	All patients	Age		Sex		Race		Ethnicity	
		10 - 14	15 - 19	Female	Male	Black	White	Hispanic	Not Hispanic
2014	1.8% (154/8720)	0.8% (40/5048)	3.6% (112/3118)	1.1% (27/2397)	2.0% (127/6312)	1.0% (11/1074)	2.1% (125/6078)	1.2% (22/1881)	1.7% (101/6103)
2015	2.4% (221/9281)	1.3% (73/5539)	4.5% (147/3258)	1.5% (37/2529)	2.8% (181/6455)	0.9% (10/1148)	2.8% (173/6073)	2.2% (41/1824)	2.5% (157/6396)
2016	4.7% (287/6141)	2.9% (101/3529)	8.4% (186/2190)	3.6% (46/1264)	5.6% (237/4195)	2.5% (14/559)	6.1% (229/3744)	4.8% (49/1022)	5.4% (231/3900)
2017	4.5% (325/7198)	2.7% (110/4142)	8.1% (213/2642)	3.5% (51/1457)	5.3% (261/4881)	2.1% (12/562)	5.5% (243/4432)	4.4% (48/1081)	4.9% (203/4157)
2018	4.7% (331/6979)	2.9% (118/4107)	8.4% (212/2515)	4.5% (66/1457)	5.4% (255/4729)	2.6% (16/616)	5.7% (242/4252)	3.9% (40/1023)	5.7% (233/4096)
2019	5.2% (394/7529)	3.0% (134/4435)	9.5% (258/2709)	4.8% (75/1574)	6.0% (306/5131)	4.9% (30/615)	6.3% (293/4647)	4.4% (49/1115)	6.1% (273/4447)
2020	6.4% (373/5862)	3.1% (114/3302)	13.3% (258/2277)	4.8% (62/1280)	7.5% (301/4021)	4.0% (17/430)	7.3% (277/3820)	6.1% (48/787)	7.1% (262/3665)
2021	6.2% (483/7764)	3.0% (137/4560)	12.0% (344/2855)	5.6% (90/1612)	6.9% (379/5499)	4.4% (32/732)	7.1% (341/4792)	6.3% (71/1136)	7.0% (340/4839)
2022	5.8% (458/7849)	2.7% (125/4642)	11.2% (328/2917)	5.1% (82/1614)	6.3% (360/5677)	3.6% (27/754)	6.8% (324/4787)	5.5% (66/1190)	6.2% (298/4845)
2023	6.4% (488/7622)	3.2% (143/4429)	11.7% (342/2917)	5.7% (85/1491)	7.1% (389/5456)	4.8% (34/711)	7.4% (339/4567)	5.2% (61/1163)	7.7% (362/4724)

Figure 1: Jointpoint Analysis of the Proportion of ORIF Procedures in Pedatric Patients with Clavicle Fractures.

1A: Proportion of ORIF Procedures in Pediatric Patients

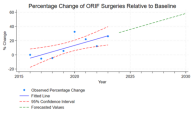


1B:Trends and Projections for Ages 10-14

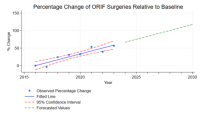
1C: ORIF Procedures for Ages 15-19

Figure 2: Demographic Trends in ORIF Procedures Among Pediatric Patients

2A: Male Patients



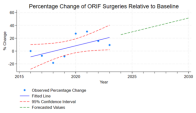
2B: Female Patients



2C: White Patients

2D: Black Patients

2E: Hispanic Patients



2F: Non-Hispanic