Industrial Lean Process Utility in Functional Neurosurgery: The Case of Microvascular Decompression

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Introduction

- Attending surgeons have concurrent obligations to deliver high quality health care and train residents (1,2).
- In modern healthcare, lean principles are increasingly being applied to the processes preceding and following surgery (3,4). However, surgeons have limited data regarding variability and waste during a given operation (5).
- We measured variability in a key functional neurosurgery procedure: microvascular decompression (MVD) for treatment of trigeminal neuralgia.
- We correlate variability with surgeons' perceptions of risk and comfort, and aim to guide surgeons as they balance operative efficiency with training obligations.

Methods

- Applied Plan, Do, Study, Act (PDSA) cycles to MVD
- Created a standard workflow diagram, segmenting the basic components of the surgery (Fig 1)
- Timed these components for 15 operations, focusing on variation and wasted time
- Surveyed surgeons' about their perceived comfort and risk for each component

Results

- The surgical components in Fig 1 were timed.
- Craniectomy had the highest duration mean and standard deviation; MVD itself had the lowest (Fig 2).
- Waste inventory showed a median wasted time of 3 mins (range 0-20 mins).
- There was a statistically significant relationship between increasing level of training and increasing perception of safety (Fig 3-4).

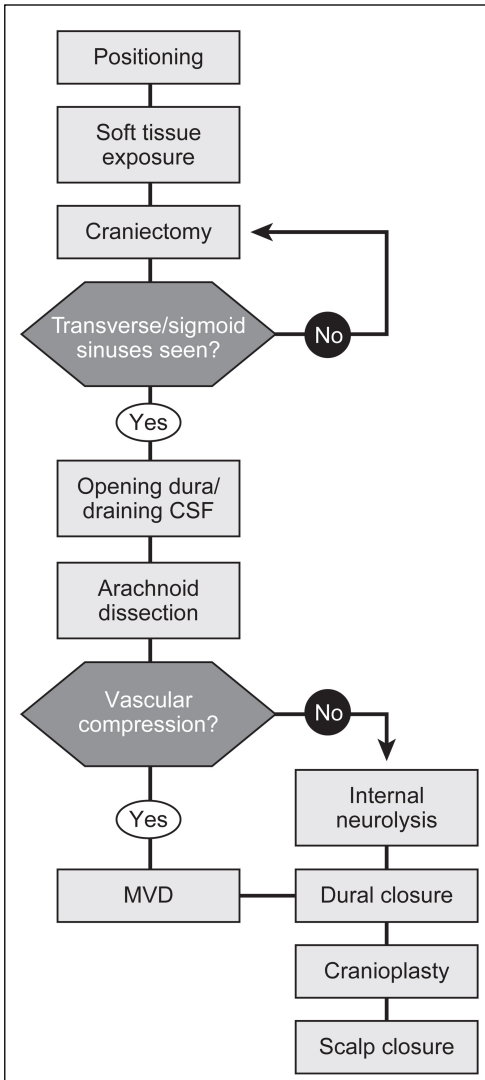

Figure 1: A standard workflow diagram was constructed, which segments the surgery into components.

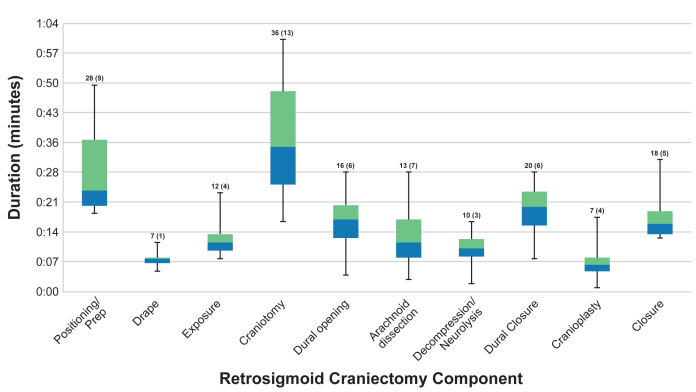

Figure 2: A box and whisker plot depicts the median duration of each surgical component and range observed. The corresponding mean duration and standard deviation is shown above each bar. The craniectomy had the highest mean duration and standard deviation (36 and 13 mins, respectively), whereas the microvascular decompression or internal neurolysis had the lowest mean duration and standard deviation (10 and 3 mins, respectively).

Figure 3: The comfort-risk matrix: we surveyed surgeons about their own perceptions of comfort and risk for each surgical component on a scale of 1-5. The results were dichotomized into safe and danger zones.

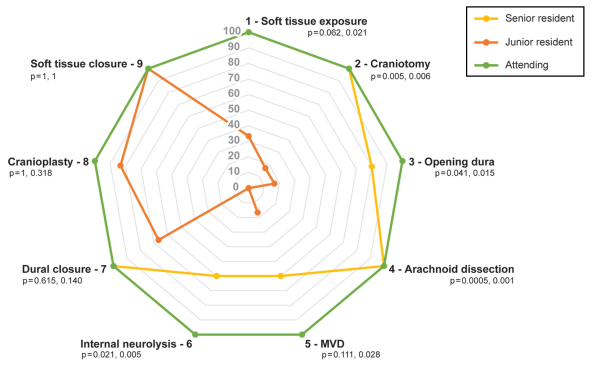

Figure 4: A radar chart shows the percent of safe zone responses for each surgical component. Fisher's exact score (first p value) assessed for differences in distributions of answers between groups, and a score test (2nd p value) assessed for whether increasing level of training corresponded to increased safe answers.

Conclusions

- Using a PDSA cycle and comfort-risk matrix, we identified components with high variability and quantified waste within a key neurosurgical procedure.
- We show significant differences in perception of comfort and risk across training levels.
- Danger zones and highly variable components often correlate. These are targets for interventions to improve trainee comfort and operative efficiency.

References

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