Novel Approach to Decrease Venous Plexus Bleeding in C1-2 Instrumentation: A Technical Note

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Introduction

Posterior atlantoaxial (C1-C2) instrumentation via the Harms technique is an effective mechanism of fixation that is often associated with excessive bleeding consequent to disruption of the venous plexus and the need to take the C2 nerve root. Here we describe a novel variation to the Harms instrumentation procedure to reduce intraoperative bleeding and damage to the C2 root.

Methods

We conducted a retrospective analysis of patients with atlantoaxial instability treated at our center. The patient's demographics, body mass index (BMI), hospital length of stay (LOS), length of surgery (LS), estimated blood loss (EBL), and peri-operative complications were analyzed using univariate analysis. The functional outcomes using the neck disability index (NDI) and visual analog scale (VAS) at basline, 6-weeks, 6-months and 1-year post-operative were evaluated and analyzed using paired t-test analysis.

Surgical technique

Surgical technique started with exposure of the arch of C1 and lamina of C2. A Penfield 1 instrument was used to carry a sub-periosteal dissection from the C2 lamina to the lateral mass and pars of C2 and upward towards the C1-C2 joint and the C1 lateral mass. This maneuver allowed for the surgeon to elevate the C2 nerve root along with the venous plexus without disruption. From this point on, the usual steps of the Harms technique were followed as previously described.

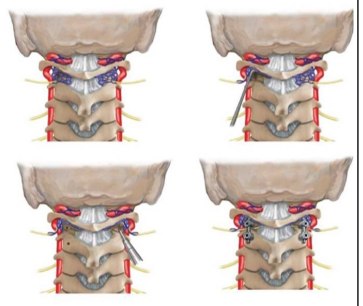
Subperiosteal dissection of the venous plexus

The Nerve root is seen and the point of entry of the C1 lateral mass screw is palpated with a Penfield 4 instrument.

Result

Thirteen patients were operated with average age 55, average BMI 25, and average LOS of 4 days. The average LS was 203 minutes and the average EBL was 114cc. Instability due to rheumatoid arthritis and tumors were the most common diagnosis, and we had no intraoperative complications. The average NDI and VAS at pre-operative compared to 1-year post-operative was found to be statistically significant (p=0.003 and p=0.009 respectively)

Steps in the modified C1-2 Harms fusion



Top Left: Normal anatomy at the C1-2 vertebral levels. Top Right: Blunt dissection of the C2 nerve root and venous plexus allows for mobilization rostrally and laterally with decreased blood loss. Bottom Left: Once the C1 lateral mass is visualized, the usual Harms technique is followed. Bottom Right: Final product of the C1-2 modified Harms technique.

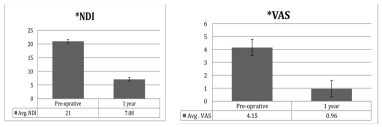
Patient's Main Diagnosis and Blood Loss During the C1-2 Trans-pars Approach

Patient #	Diagnosis	EBL	LOS	BMI
1	Type 2 odontoid fracture	50	2	26.22
2	C1-C2 instability/ rheumatoid disease	50	1	19.98
3	C1-C2 instability/ rheumatoid disease	150	2	21.2
4	Type 2 odontoid fracture	75	3	23.17
5	C1-C2 instability/ rheumatoid disease	50	8	21.8
6	C1-C2 instability with metastatic tumor	100	7	23.1
7	C1-C2 instability with C2 tumor	500	8	28.1
8	Type 2 odontoid fracture	50	3	20
9	C1-C2 instability with os odontoideum	50	2	20
10	C1-C2 instability with C2 tumor	60	2	32.5
11	C2 os odontoideum	150	3	38.1
12	C1-C2 instability with metastatic multiple myeloma	200	4	32.4
13	C1-C2 instability/ rheumatoid arthritis	25	7	30.4

EBL denotes estimated blood loss in milliliters, LOS length of hospital stay in days, and BMI body mass index in kg/m2.

Functional outcome according to pre- and post-operative time point

Parameter	Baseline	6-weeks	6-months	1-year	p-value[a]
NDI	21	47	36	7	0.003
VAS	4.28	4.6	2.85	0.96	0.009



NDI = Neck Disability Index; * denotes statistical significance. VAS = Visual Analog Scale; * denotes statistical significance. aReflects comparison between pre-operative and 1-year post-operative time points.

Conclusion

The Harms technique in C1-C2 stabilization is an excellent option in the treatment of atlantoaxial instability, with one of the only draw backs being an increased blood loss often resulting from disruption of the venous plexus at this level. We present a variation that allows for a greater visualization of the venous plexus and C2 nerve root, and thus a decreased risk of associated blood loss and the need to take the C2 nerve root as compared to the published standard and similar improvement in VAS and NDI as previously published. Due to the improved visualization, this allows the surgeon better anatomical trajectory and decreases the risk of vertebral artery injury. We believe that this technique can serve to optimize an already efficient and efficacious surgical technique.

References

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