TOMOGRAPHIC CORRELATION OF THE MAGERL TECHNIQUE FOR C1-C2 ARTHRODESIS IN RHEUMATOID ARTHRITIS

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ABSTRACT

Objective: To use the tomographic analysis of C1 and C2 vertebrae to assess the possibility of using Magerl's technique in patients with rheumatoid arthritis. Other objectives were to obtain anatomical data for the choice of the surgical technique in general, to establish safety parameters and obtain epidemiological data of the population in question. Methods: We retrospectively reviewed the CT scans of 20 patients with rheumatoid arthritis of the Outpatient Spine Group, IOT-HCFMUSP. Data were analyzed statistically to obtain the mean values and the variance of each measurement: the length of the C2 pedicle to the C1 lateral mass, the thickness of the pedicle and the angle of attack of the screw in the isthmus of C2 to the horizontal. Results: The mean values were, respectively: right 23.08 mm and left 23.16 mm, right 6.46 mm and left 6.50 mm, right 44.50º and left 44.95º. Discussion: The leading screw's manufacturers have implants compatible with the anatomical measurements found in this work. Considering the wide diffusion and mastery of Magerl's technique in our country and around the world, this is a safe surgical option that provides mechanical stability. Conclusion: Magerl's technique, according to tomographic analysis, can be used in patients with rheumatoid arthritis. ***Levels of Evidence IV,Case Series.***

Keywords: Arthrodesis. Arthritis, rheumatoid. Tomography.

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INTRODUCTION

Rheumatoid arthritis is a systemic inflammatory disease that is accompanied by lymphoproliferative synovial impairment, which produces cartilage destruction, periarticular erosion and weakening of ligaments and tendons. Among all the possible complications of this weakening, cervical instability is the most severe and potentially lethal, being present in 19% to 88% of patients.[1]

Instability in cervical vertebrae C1-C2 can be treated conservatively, with a neck brace, or surgically, depending on clinical and radiographic parameters. In the lateral radiographic exam (x-ray or computed tomography) of the cervical spine the instability is demonstrated by the distance from the anterior odontoid cortex to the anterior arch of C1, demonstrating degrees of insufficiency or injury of the transverse ligament. In an adult this distance is normal up to 3 mm, with slight instability between 4-6 mm, moderate instability between 7-9 mm and severe instability, with certainty of transverse ligament rupture, in values above 9 mm.[1]

Older surgical techniques for arthrodesis of the C1-C2 vertebrae used steel wiring around the spinous processes. In the early 20th century, Mixter and Osgood[2] described the cerclage of the spinous processes of C1 and C2 with silk threads. A few years later, Gallie[3] described the cerclage technique through the C1 and C2 laminae. The disadvantages of cerclage techniques were the risk of neurological injury in the passage of the wires, the need to use stiff external orthosis, and the high rates of non-union.

Techniques have been developed more recently with transarticular C1-C2 screws and screws on C1 lateral mass and on C2 pedicle and lamina, achieving better rates of consolidation without the need for a postoperative brace,[4,5] yet increasing the risk of injury to the vertebral artery and precluding the use of the technique in the presence of an irreducible dislocation above 50%. The use of screws in spinal stabilization surgeries has become increasingly common. Magerl's technique advocates the stabilization of C1-C2 vertebrae with the use of transarticular screws.[4-7] After reduction under lateral fluoroscopic guidance

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the surgeon creates a posterior approach at the levels of C1 to C3. The screws are passed from a point 2 mm lateral to the spinous process and 3 mm above the articular process of C2 with C3. The surgeon drills through the isthmus of C2 towards the C1 lateral mass. With this technique 3.5 mm screws are used, hence this diameter is the minimum condition for their use.

The study of the anatomy of the C1-C2[8-11] cervical vertebrae is important to act as a guideline for the choice of surgical technique, besides prompting a discussion about the use of the same stabilization technique described by Magerl for pathologies with similar anatomopathological alterations.[12,13]

The aim of this study was to evaluate, using the study of anatomy, the possibility of using the Magerl technique in the stabilization of C1-C2 vertebrae of patients with rheumatoid arthritis, and also to enable deeper discussions concerning the technique used to stabilize these vertebrae, to provide data for the performance of the Magerl technique with greater patient safety and to obtain epidemiological data on the outpatient population of the Spine Group of IOT-HCFMUSP.

METHODS

We analyzed 20 tomography scans of patients with rheumatoid arthritis acquired for the diagnosis and surgical planning of outpatients of the Spine Group of IOT-HCFMUSP. The dimensions and angulations of the laminae were evaluated by means of the image program ImageJ®. All the measurements were made in millimeters, except for the angle of attack that was measured in degrees. Individuals diagnosed with rheumatoid arthritis through radiological/laboratorial clinical exams without previous cervical spine surgery were considered sufficient inclusion criteria. There are no exclusion criteria.

The distance from the posterior cortex of the anterior arch of C1 to the anterior odontoid cortex was measured according to Figure 1A. The measurements of length of the posterior cortex of the C2 pars, obliquely, towards the anterior cortex of the C1 lateral mass were taken according to Figure 1B. The thickness of the pedicle, from the posterior superior pedicle cortex to the anterior inferior pedicle cortex, at its narrowest point and at an angle of 90º with its lengthwise measurement, was measured according to Figure 1C. The angles of attack to the horizontal, for the entrance of the screw in the posterior cortex of the C2 pars, crossing the pedicle and heading to the anterior cortex of the C1 lateral mass, were measured according to Figure 1D. Measurements B, C and D were obtained individually on each side. The data obtained by the study were analyzed statistically so as to obtain mean values, as well as the variation for each measurement taken.

RESULTS

Of the 20 CT scans included in the study, 17 were of female patients and three of male patients, while the average age of the study subjects was 59 years for men and 60.47 for women. Table 1 shows the means of the measurements obtained and their standard deviations. The comparative analysis between right and left sides for pedicle thickness, pedicle length and angle of attack, did not reveal any difference between sides ($p = 0.904$, 0.913, 0.736 respectively). The maximum and minimum limits of length and thickness from the C2 pedicle to the C1 lateral mass were included in Table 2.

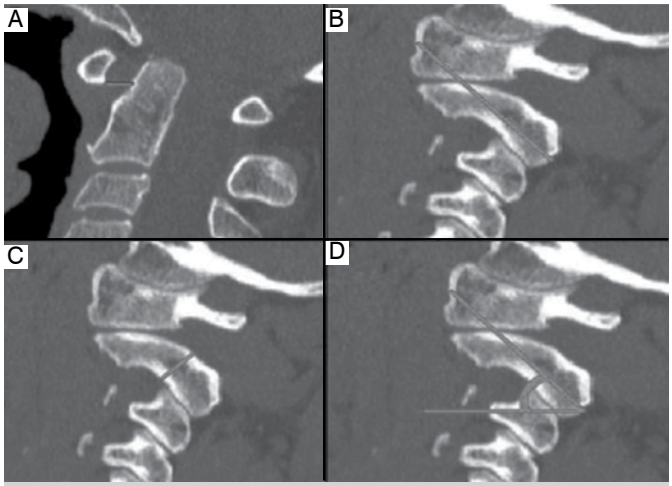

Figure 1. Model of obtainment of measurements in the sagittal section of the C1-C2 CT scan. (A) posterior cortex of the anterior arch of C1 and anterior odontoid cortex. (B) Length of C2 pedicle + C1 lateral mass (from the posterior cortex of the C2 pars, obliquely, towards the anterior cortex of the C1 lateral mass). (C) Thickness of C2 pedicle at its narrowest point and perpendicular to its longest measurement from the posterior superior cortex to the anterior inferior cortex. (D) Angle of attack to the horizontal for entrance of the C2 posterior cortex screw, crossing the pedicle and heading to the anterior cortex of the C1 lateral mass.*- Measurements B, C and D were made individually on the left and right sides.

Table 1. Mean values obtained for each side.

	Length from the C2 pedicle to the C1 mass	Thickness of the C2 pedicle	Angle of attack of the screw to the horizontal	Distance from the C1 arch to the odontoid
Right	23.08 mm (±2.40)	6.46 mm (±0.94)	44.50º (±8.78)	3.25 mm (±2.20)
Left	23.16 mm (±2.51)	6.50 mm (±1.79)	44.95º (±7.60)	

Table 2. Maximum and minimum values obtained for each side.

	Length from the C2 pedicle to the C1 mass		Thickness of the C2 pedicle in the direction of the C1 lateral mass		Angle of attack of the screw to the horizontal	
	Right	Left	Right	Left	Right	Left
Maximum value	28.20 mm	26.40 mm	8.50 mm	9.50 mm	59º	56º
Minimum value	17.50 mm	18.20 mm	5.20 mm	2.00 mm	28º	26ºº

DISCUSSION

Some considerations should be made when we assess the possibility of using the Magerl technique for transarticular fixation of the C1-C2 vertebrae. First of all, it is necessary to conduct an anatomical study of the cervical region in question,[8,10-13] then to understand the mechanics of instability and its physiopathology. Moreover, the implant materials available in the market must be

compatible with the vertebrae to be fixed. In Figures A, B and C, we show the distribution of values obtained respectively for the pedicle length, for its thickness and for the angle of attack for the entrance of the screw in the C2 posterior cortex.

Screws with a diameter of 3.5 mm and lengths that range between 12 and 30 mm are habitually found in the market. The data of our study are widely understood. In our study, the smallest measurement of pedicle thickness was 2 mm, being found in only one patient and only on the left side, as demonstrated in Figure 2. In the same patient, the measurement of the right side was 5.6 mm. Thus we believe that it is an anatomical variation, and that this measurement is not statistically significant. It is worth mentioning that the second smallest measurement of thickness of the pedicle on the left side is 3.9 mm and the smallest right side measurement is 5.2 mm.

Accordingly, anatomical measurements found in this study are appropriate for the use of most screws commercially available in the market. The adaptation of the measurements to the implants is essential for the success of the technique.

Magerl's technique is already well established and publicized in our field and worldwide, and is a safe and mechanically stable surgical option. Several surgeons master the surgical steps of this procedure and use it regularly. The studies show good results of this technique in terms of the safety and consolidation rates of arthrodesis.[4-6]

The greatest limitation of this study is the small sample of patients, particularly with regards to the numbers of male patients, only three individuals, owing, among other reasons, to the relative low prevalence of the disease in men.

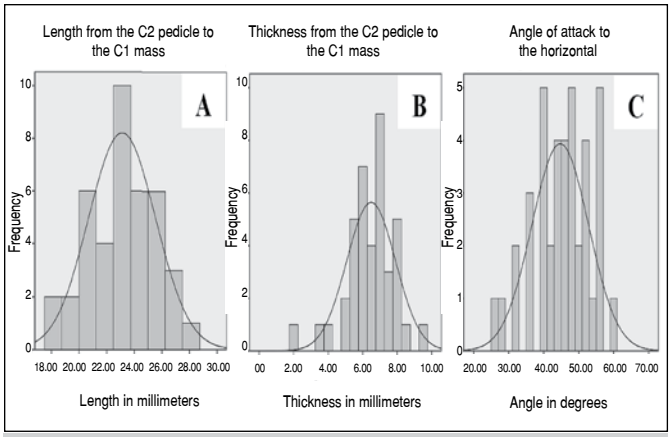

Figure 2. Distribution of the values found.

Due to the limited presence of male individuals in the study group, it was not possible to perform a comparative analysis of the values between sexes. Due to the disproportion between men and women in this study we did not make a comparison with the results of the study with healthy patients[12] which presented approximately half of the individuals of each sex.

CONCLUSION

According to the anatomical measurements taken, through studies using computed tomography, it was proven that Magerl's technique can be employed safely in patients with rheumatoid arthritis.

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