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Evaluation of the Presence of the Third Head on the Lateral Pterygoid Muscle in Adult Individuals

Evaluación de la Presencia de la Tercera Cabeza del Músculo Pteriogoideo Lateral en Individuos Adultos

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SUMMARY: The lateral pterygoid muscle (LPM) is one of the muscles involved in jaw movements, and is therefore of great importance in the physiology of the temporomandibular joint. This muscle has classically been considered to have two heads, superior and inferior, however previous studies have indicated the presence of a third head (TH). The object of this research was therefore to evaluate, through a study in cadavers, the presence of the third head of the LPM and its relation with the joint disc of the TMJ in adult individuals. The study used 30 half-skulls of adult individuals, 11 right side and 19 left side. The number of heads on each LPM was analysed, with the length and thickness of each. The Chi-squared, Mann-Whitney U, Kruskall-Wallis and Spearman's correlation coefficient tests were applied, with a significance threshold of 5 %. The TH of the LPM was present in 20 % of the samples. Statistically significant differences were found in the thickness of the superior head (SH) vs. the inferior head (IH) ($p<0.001$) and between TH vs. SH and TH vs. IH ($p=0.010$). No correlation was found between the thickness of the heads or in their lengths. The LPM most frequently presents two heads, superior and inferior. The TH is an anatomical variation that may be present in 20 % of cases. The IH usually presents the greatest thickness. The use of cadavers is a good method for analysing the presence of the TH and the morphometry of the various heads of the LPM.

KEY WORDS: Lateral pterygoid muscle; Anatomical variations; Morphometry; Cadaver.

INTRODUCTION

The lateral pterygoid muscle (LPM) is one of the muscles involved in jaw movements, and is therefore of great importance in the physiology of the temporomandibular joint (TMJ) and in disorders that may affect this joint (Alves & Cândido, 2016). The LPM has classically been considered to have two heads, superior and inferior. The superior head (SH) originates on the infratemporal face of the greater wing of the sphenoid, and on the superior third of the lateral face of the lateral lamina of the pterygoid process of the sphenoid (Moore & Dailey, 2013; Alves & Cândido). The inferior head (IH) originates on the inferior two thirds of the lateral face of the lateral lamina of the pterygoid process and on the lateral face of the pyramidal process of the palatine (Alves & Cândido). The IH of the LPM is inserted into the fovea pterygoidea, while the insertion of the SH is variable. Altruda Filho & Alves (2006) showed by histological analysis that the insertion of the SH of the LPM in foetuses occurs in the disc and joint capsule of the TMJ. In adult individuals the SH of the LPM is inserted into the fovea pterygoidea and the joint capsule of the TMJ in most cases (Kiliç *et al*., 2010; Antonopoulou *et al*., 2013; Litko *et al*., 2016). In a smaller number of cases, insertion is only observed into the fovea pterygoidea, and in rare cases only into the joint capsule of the TMJ (Antonopoulou *et al*.; Litko *et al*.). Although in the majority of cases the LPM presents with two heads (Stöckle *et al*., 2019; Farfán *et al*., 2020), some authors report the presence of a third head (TH), observed in between 20 % and 30.7 % of cases (Sugisaki *et al*., 1986; Pompei Filho *et al*., 2009). Detailed study of the morphology of the LPM is of fundamental importance in anatomy; it helps in precise diagnosis of temporomandibular disorders and consequently in patient rehabilitation. The object of this

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research was therefore to evaluate, through a study in cadavers, the presence of the third head of the LPM and its relation with the joint disc of the TMJ in adult individuals. Additionally, we carried out a morphometric analysis of the different heads of the LPM.

MATERIAL AND METHOD

Thirty half-skulls of 29 adult individuals were examined, 11 right sides and 19 left sides, belonging to the laboratory of human anatomy of the Institute of Biological Sciences and Health of Universidad Federal de Alagoas, Maceió, Brazil. The samples were fixed in formalin and were not identified by sex, age or ethnic group. Analysis of the LPM followed the dissection protocol used by Antonopoulou *et al*.

An incision was made along the inferior margin of the zygomatic arch, the area of origin of the masseter muscle, reflecting down this muscle through the incision. A piece of the zygomatic arch was removed with a rongeur. Two cuts were made in the zygomatic arch for this purpose, an anterior cut at the limit between the body and the temporal process of the zygomatic bone, and then a posterior cut in front of the articular tubercle of the temporal bone. Removal of the piece cut from the zygomatic arch gave access to the temporal fascia; this was cut and reflected to expose the temporal muscle, which is inserted into the coronoid process and the temporal crest of the mandible. Osteotomy of the coronoid process was carried out and the temporal muscle was retracted upward, allowing access to the infratemporal fossa. The medial and lateral pterygoid muscles and the vasculo-nervous structures of the region were located. After the heads of the LPM had been identified, the length (distance from origin to insertion of the LPM) and the thickness of each head of the LPM were measured using a calliper. The measurements were taken twice by the same evaluator, at different times.

Statistical analysis. Levene's test was used to evaluate the homogeneity of the variances, and the Shapiro-Wilk test to analyse the normality of the data. The Mann-Whitney U test and the Kruskall-Wallis test were used for the quantitative variables, with testing by the pairwise method. Spearman's correlation coefficient was used to analyse the correlations between lengths and between the thickness of the heads. Spearman's correlation was classified as nil (r=0), very low (r<0.2), low (between 0.2 and 0.4), moderate (between 0.4 and 0.6), high (between 0.6 and 0.8), very high (r>0.8) and perfect (r=1) (Schober *et al*., 2018). Intra-observer analysis was carried out by interclass correlation (ICC) analysis. The association was classified as poor (0.0), slight (0.01-0.20), regular (0.21-0.40), moderate (0.41-0.60), substantial (0.61-0.80) or almost perfect (0.81-1.00) (Landis & Koch, 1977). Statistical analysis used the SPSS software, v. 27.0, with significance threshold of 5 %.

RESULTS

The ICC was greater than 0.808 (almost perfect) for all the measurements of quantitative variables. Thirty samples (half-skulls) were analysed, of which 11 were right side (36.7 %) and 19 left side (63.3 %). The LPM in 24 samples presented two heads (80 %), however in 6 samples (20 %) three heads were observed.

The SH of the LPM presented a mean length of 3.0 cm (SD= 0.33 cm) and mean thickness of 0.86 cm (SD= 0.27); the IH presented a mean length of 3.08 cm (SD= 0.35) and mean thickness of 1.33 cm (SD= 0.37); the third head (TH) presented a mean length of 2.82 cm (SD= 1.31) and mean thickness of 0.75 (SD= 0.40). In the correlation analysis no statistically significant differences were found for the length or the thickness of the three heads (p>0.05).

The means and interquartile ranges for the thickness and length are shown in Table I. No statistically significant differences were found for the length of the LPM heads. Statistically significant differences were found for the thickness of the heads between SH vs. IH (p<0.001) and between TH vs. IH (p=0.010).

The TH of the LPM was present in 6 samples (20 %), 3 on the right side and 3 on the left side. The origin of the TH was in the greater wing of the sphenoid in 2 cases (33.3 %) and below the superior fascicle in 4 cases (66.6 %). The insertion of the TH was in the capsular disc complex in all cases. No statistically significant differences were found for the length (p=0.240) and thickness (p=0.254) by origin of the TH.

Table I. Medians, Interquartile Ranges (IQR) and p values for the distances, lengths and thicknesses of the superior, inferior and middle fascicles of the LPM.

Head	Length	Width
	Median (IQR)	Median (IQR)
Superior	3.00 (0.40)	0.80 (0.30)*
Inferior	3.20 (1.40)	1.40 (0.50)†
Middle (Third)	3.40 (0.70)	0.90 (0.30)*†
P-value	0.140	<0.001

*p<0.001; †p<0.05.

DISCUSSION

Knowledge of the anatomy of the LPM is of fundamental importance in various fields, such as biomechanical studies, when studying and quantifying its actions (Alves & Cândido); in surgery of the infratemporal fossa, to ensure proper planning and a successful surgical strategy (Akar *et al*., 2009); and in clinical practice, since some disorders of the TMJ are related with the LPM and thus knowledge of its anatomy helps in precise diagnosis and consequently in patient rehabilitation (Wilkinson, 1988).

The authors state that the most frequent form of the LPM in anatomical studies is with two heads, superior and inferior. The presence of two heads may vary between 57.6 % (Sugisaki *et al*.) and 65 % (Fujita *et al*., 2001). Variations have been reported, however, such as the presence of a third head (Stöckle *et al*.), or even a single head – the least frequent form, varying between 7.7 % (Sugisaki *et al*.) and 15 % of cases (Naohara, 1989). The location of the TH of the LPM is more medial than the SH and at a greater angle to the sagittal plane than the IH. In the present study we analysed the number of heads of the LPM; no sample with a single head was found. The frequency of LPM with two heads was 80 % (24/30), while in 20 % of the cases (6/30) the third head was present, corroborating the findings of Naohara and Antonopoulou *et al*., who found similar percentages for the presence of the third head. Previous studies based on images corroborate our findings, showing that the third head of the LPM is present in at least 20 % of cases, as reported by Pompei Filho *et al*. Nevertheless, higher percentages have been reported, up to 35 % (Fujita *et al*.) and 36 % (Akar *et al*.).

In the present study we also carried out a morphometric analysis of the LPM, measuring the thickness and length of each head. Morphometric data are important for the detailed anatomical information of the LPM that they provide. Akar *et al*., showed that the length found for the third head presented a higher value than the lengths of the SH and the IH; the same was observed in our study, however no statistically significant differences were found. In our study the thickness of the IH was greater than that of the third head, and the thickness of the third head was greater that that of the SH. Akar *et al*., reported that the IH was three times as thick as the SH; this was not observed in our study, since although the values for the IH were greater than those observed for the SH, the results were not statistically significant.

The LPM has aroused great interest in both clinical practice and scientific research; it continues to be quite widely studied, perhaps because it plays such an important role in mandibular movement and the physiology of the TMJ. Nonetheless, there is a clear lack of unanimity in the literature on various aspects, such as the number of heads.In this study we evaluated the presence of the third head of the LPM and its relation with the joint disc of the TMJ in adult individuals; we also carried out a morphometric analysis of the different heads of the LPM in order to contribute to anatomical knowledge.

CONCLUSION

The LPM most frequently presents two heads, superior and inferior. The third head is an anatomical variation that may be present in 20 % of cases. The inferior head usually presents the greatest thickness. The use of cadavers is a good method for analysing the presence of the third head and the morphometry of the various heads of the LPM.

TORRES, V. C.; DEANA, N. F.; DE SOUSA-RODRIGUES, C. F. & ALVES, N. Evaluación de la presencia de la tercera cabeza del músculo pteriogoideo lateral en individuos adultos. *Int. J. Morphol., 39(5)*:1270-1273, 2021.

RESUMEN: El músculo pterigoideo lateral (MPL) es uno de los músculos involucrados en los movimientos mandibulares y por consiguiente tiene una gran importancia en la fisiología de la articulación temporomandibular (ATM). Clásicamente se ha considerado como un músculo que presenta dos cabezas, una superior y otra inferior, sin embargo estudios anteriores han señalado la presencia de una tercera cabeza (TC). El objetivo fue evaluar, mediante estudio en cadáveres, la presencia de la tercera cabeza del MPL y su relación con el disco articular de la ATM de individuos adultos. Se utilizaron 30 hemicabezas de individuos adultos, 11 del lado derecho y 19 en el lado izquierdo. Se analizó el número de cabezas, longitud y grosor de cada cabeza. Se aplicaron las pruebas de chi-cuadrado, U-Mann-Whitney, Kruskall-Walis y coeficiente de correlación de Spearman, con umbral de significación de 5 %. La TC del MPL estuvo presente en 20 % de las muestras. Se encontraron diferencias estadísticas significativas para el grosor del la cabeza superior (CS) vs. cabeza inferior (CI) ($p<0,001$) y entre TC vs. CS y TC vs. CI ($p=0,010$). No se encontró correlación entre el grosor de las cabezas o para la longitud de las cabezas. El MPL se presenta más frecuentemente con dos cabezas, una superior y otra inferior. La TC es una variación anatómica que puede estar presente en un 20 % de los casos. La CI suele ser la que presenta mayor grosor. En cuanto a los métodos para análisis de presencia de la TC y morfometría de las distintas cabezas del MPL el uso de cadáveres representa una buena alternativa.

PALABRAS CLAVE: Músculo pterigoideo lateral; Variaciones anatómicas; Morfometría; Cadáver.

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