
Original Research

CHANGES IN CONFIGURATION OF THE HIP DUE TO CHIARI OSTEOTOMY

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ABSTRACT

Changes in the position of the femoral-head center and the center-edge angle secondary to the Chiari osteotomy were studied in order to determine changes in the configuration of the hip caused by the operation. The final analysis included 28 adult female patients (median age 33 years) in whom the change of hip geometry due to the Chiari osteotomy clearly could be determined from radiographs before and after the operation. The correlation/regression analysis showed lack of interdependence between the femoral-head center shift and the increase of the weightbearing area. The results suggest that the Chiari osteotomy can increase the weightbearing area as a result of a shift of the femoral-head center and/or a shift of the proximal part of the pelvis above the osteotomy.

Nous avons étudié les modifications du centre de la tête fémorale et de l'angle de couverture après ostéotomie de Chiari. Nous avons pu inclure 28 dossiers (28 femmes d'âge moyen 33 ans) pour lesquels les modifications de la géométrie de la hanche liées à l'ostéotomie de Chiari ont pu être clairement analysées à partir des clichés pré et post-opératoires.

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L'analyse de corrélation et régression a montré l'absence de lien entre la modification du centre de la tête fémorale et l'augmentation de la surface portante. Les résultats semblent montrer que l'ostéotomie de CHIARI permet d'augmenter la surface portante soit par le biais de la modification de centrage de la tête fémorale, soit par le biais des modifications du bassin au dessus de l'ostéotomie.

Translated by Patricia Thoreux, MD

Zur Beurteilung postoperativer Veränderungen wurde die Verschiebung des Femurkopf-Zentrums und des CE-Winkels nach Chiari-Osteotomien untersucht. Die Analyse erfasste 28 weibliche Patienten (durchschnittliches Alter 33 Jahre) die im Vergleich der prä- und postoperativen Röntgenaufnahmen nach Chiari-Osteotomien eine eindeutige Veränderung der Hüftgeometrie aufwiesen. Die Korrelations/Regressions Analyse ergab eine fehlende Interdependenz zwischen dem Femurkopf-Zentrum und der Vergrößerung der gewichtstragenden Fläche. Die Ergebnisse lassen darauf schliessen, dass sich die Vergrößerung der gewichtstragenden Fläche nach Chiari-Osteotomien aus der Verschiebung des Femurkopf-Zentrums und/ oder aus der Verschiebung des proximalen Beckens über die Osteotomie ergibt.

Translated by Niklaus F. Friederich, MD

Con el objeto de determinar cambios en la cadera como resultado de la osteotomía tipo Chiari se estudiaron las modificaciones en la posición del centro de la cabeza femoral y el borde del ángulo central. El análisis final incluyó 28 mujeres adultas (edad promedio 33

años) en quienes los cambios de la geometría de la cadera debido a la osteotomía tipo Chiari pudieron ser claramente determinadas con los radiografías pre y post operatorias. La correlación y análisis de regresión mostraron una falta de interdependencia entre la modificación del centro de la cabeza femoral y el incremento en el área de soporte de peso. Los resultados sugieren que la osteotomía tipo Chiari puede incrementar el área de soporte de peso como resultado de la modificación del centro de la cabeza femoral y/o una modificación de la parte proximal de la pelvis por arriba de la osteotomía.

Translated by M. Sigfrido Rangel-Frausto, MD, MSc

Vengono studiate le variazioni di posizione del centro della testa femorale e dell'angolo di copertura del tetto acetabolare dopo osteotomia di Chiari al fine di valutare i cambiamenti che questo tipo di intervento determina sulla morfologia dell'anca. L'analisi finale include 28 pazienti femmine adulte (età media 33 anni) in cui i cambiamenti della geometria dell'anca in seguito ad osteotomia di Chiari sono stati valutati sulla base di radiografie pre e postoperatorie. L'analisi comparativa radiografica ha mostrato una mancata interdipendenza tra lo spostamento del centro dell'epifisi femorale e l'incremento dell'area di carico. I risultati sug-

Professor Karl Chiari¹ from Vienna first performed the Chiari osteotomy in 1950, and published the first articles^{2,3} on his operation in 1953 and 1956. The Chiari osteotomy is performed to increase femoral head coverage; it is indicated when an acetabuloplasty is needed but the Pemberton, Salter, triple osteotomy, and shelving operations are not feasible. The Chiari osteotomy is indicated to relieve pain and to postpone the development of hip arthrosis in cases of hip subluxation with impossible concentric reduction and in selected cases of acetabular dysplasia.⁴⁻¹⁰ The most important effect of the Chiari osteotomy is immediate and continued relief of pain.^{9,11} Long-term results are favorable,^{6,11,12} and the best results are achieved in the younger patients.^{7,11}

The Chiari osteotomy extends from above the hip joint moving laterally toward the greater sciatic notch in an ascending direction, dividing the hemipelvis into a proximal and a distal segment.³ The proximal segment is the *ala ossis ilii* and the distal one comprises the femoral head with the acetabulum and the capsule. Additional femoral head coverage in the Chiari osteotomy is obtained by shifting the distal pelvic osteotomy segment

geriscono che l'osteotomia di Chiari può incrementare l'area di carico come risultato dello spostamento del centro dell'epifisi femorale e della traslazione della parte prossimale del bacino al di sopra dell'osteotomia.

Translated by Pier Giorgio Marchetti, MD

キアリ骨切り術によって起こる股関節の配置の変化を決定するために、大腿骨頭中心の位置の変化および CE 角の変化を研究した。最終的に解析対象としたのは、キアリ骨切り術による股関節の位置変化が術前術後の X 線写真で明らかに決定できる 28 例の成人女性患者 (年齢中央値 33 歳) であった。相関/回帰分析の結果、大腿骨頭中心の位置変化と荷重面積増加との間に相互従属関係が無いことが示された。今回の研究の結果は、キアリ骨切り術を行うことによって大腿骨頭中心の位置変化と骨切り部の上での骨盤中核側の変位のいずれかまたはその両方が起こる結果、荷重面積を増加できることを示唆している。

Translated by Katsuji Shimizu, MD

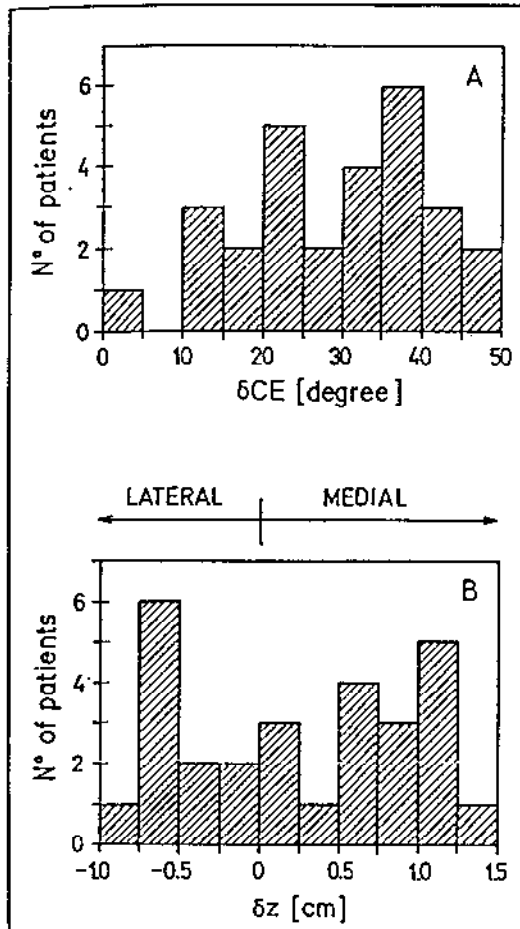
relative to the proximal one. The additional coverage has the shape of a triangle, with the base aligned medially and the apex laterally, and depends on the technique used.^{11,13}

The objective of this study was to determine how this additional coverage is achieved. In particular, we investigated which parts of the pelvis (the distal or the proximal or both) are shifted by the osteotomy. We studied the change of position of the femoral head center in the mediolateral direction, the change of the center-edge angle of Wiberg,¹⁴ and the correlation between these two variables.

PATIENTS AND METHODS

We analyzed 130 patients undergoing 147 Chiari osteotomies from 1981 to 1990. The same operative technique, involving a straight ascending osteotomy performed with a chisel,³ was used in all cases. The duration of the operation was about 1 hour. A plaster cast was applied for 4 to 6 weeks, and one to two screws used for fixation of the osteotomy were removed after about 15 months. Radiographs were taken a few days before the operation and at most 1 year after the

Fig 1: Changes of the CE angle δCE (A) and of the femoral head center position δz (B) following the Chiari osteotomy.



operation. A standardized technique with a magnification rate of 10% was used.

Close to 90% of the patients were women, and all patients showed residual hip dysplasia after developmental dislocation of the hip. Of the 130 patients, only those for whom the distance between the two femoral head centers and the center-edge (CE) angle could be determined accurately from the radiographs were included in the final analysis. Patients younger than 18 years were excluded, because the change in the distance between the two femoral head centers that may have occurred between the two radiographic examinations was likely caused by the patient's growth. Seventeen patients (34 cases) undergoing bilateral operation were excluded, because it was not possible to establish how much an individual hip contributed to the change of the distance between the two femoral head centers. Two patients who developed necrosis of the femoral head with subsequent total hip replacement were omitted from the study, and patients were omitted because of incomplete records.

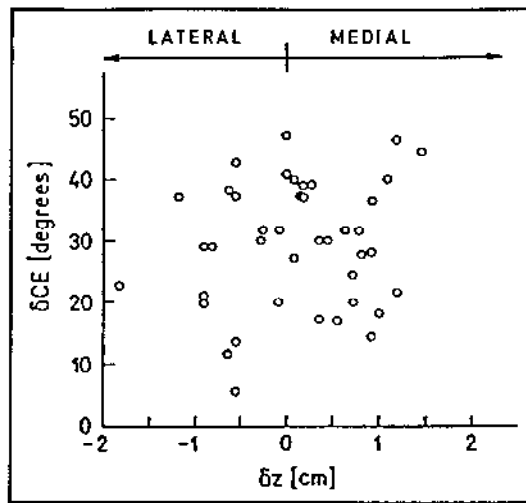


Fig 2: Scatter diagram of the change of the CE angle (δCE) and the femoral head center shift (δz).

Thus, the final analysis involved 28 of 147 cases, all women. These patients ranged in age from 19 to 49 years (median: 33 years). The change of the CE angle and the femoral head center shift in the mediolateral direction were measured from the radiographs taken before and after the operation. The comparatively short follow-up time allowed us to assume that during this interval the configuration of the hip could not have changed appreciably for reasons other than the operation. The femoral head center was determined by a template with Mose's rings.¹⁵ Changes of the CE angle and of the femoral head center position caused by the operation were recorded as median values. The correlation/regression analysis¹⁶ was applied to assess the interdependence of the change of the CE angle and the femoral head center shift.

RESULTS AND DISCUSSION

Histograms illustrating the change of the CE angle (δCE) and the femoral head center shift in the mediolateral direction (δz) caused by the operation are shown in Figure 1. It can be seen that neither distribution is normal. The change of the CE angle ranged from 3.64° to 47.22° (median: 30.94°), showing that the CE angle was increased in all cases. The femoral head center shift was between -0.91 cm and 1.45 cm (median: 0.27 cm), indicating that the femoral head can be moved either laterally (negative values) or medially (positive values).

Next, the interdependence between δCE and δz was investigated. A scatter diagram of δCE and δz is shown in Figure 2. A null hypothesis, assuming absence of a linear relationship between the variables, was adopted. The calculated t values [$t(\delta CE/\delta z) = 1.02$] and the corresponding probability [$P(\delta CE/\delta z) = .32$] indicate that the null hypothesis cannot be rejected, meaning there is no correlation between δCE and δz .

We formerly believed that the Chiari operation always produced a medial shift of the femoral head, thereby increasing the coverage.^{13,17,18} The presented experimental analysis shows, however, that the coverage also can be increased by a lateral shift of the femoral head (ie, the proximal part of the pelvis above the osteotomy also can be shifted during the operation). This is further confirmed by the lack of correlation between δCE and δz .

In conclusion, our results show that the lateral coverage can be increased by shifting the femoral head and by shifting the proximal part of the pelvis above the osteotomy. If the femoral head is assumed to coincide with the rotation center, its medialization is preferable to its lateralization. This follows from calculations¹⁹ showing that medialization reduces the resultant hip force, whereas lateralization increases it.

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