



## ORIGINAL ARTICLE

# Short-term corneal changes with gas-permeable contact lens wear in keratoconus subjects: A comparison of two fitting approaches



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Received 22 June 2014 ; received in revised form 11 July 2014

Available online 4 September 2014

### KEYWORDS

Cornea;  
Keratoconus;  
Contact lenses

### Abstract

**Purpose:** To evaluate changes in anterior corneal topography and higher-order aberrations (HOA) after 14-days of rigid gas-permeable (RGP) contact lens (CL) wear in keratoconus subjects comparing two different fitting approaches.

**Methods:** Thirty-one keratoconus subjects (50 eyes) without previous history of CL wear were recruited for the study. Subjects were randomly fitted to either an apical-touch or three-point-touch fitting approach. The lens' back optic zone radius (BOZR) was 0.4 mm and 0.1 mm flatter than the first definite apical clearance lens, respectively. Differences between the baseline and post-CL wear for steepest, flattest and average corneal power (ACP) readings, central corneal astigmatism (CCA), maximum tangential curvature (KTag), anterior corneal surface asphericity, anterior corneal surface HOA and thinnest corneal thickness measured with Pentacam were compared.

**Results:** A statistically significant flattening was found over time on the flattest and steepest simulated keratometry and ACP in apical-touch group (all  $p < 0.01$ ). A statistically significant reduction in KTag was found in both groups after contact lens wear (all  $p < 0.05$ ). Significant reduction was found over time in CCA ( $p = 0.001$ ) and anterior corneal asphericity in both groups ( $p < 0.001$ ). Thickness at the thinnest corneal point increased significantly after CL wear ( $p < 0.0001$ ). Coma-like and total HOA root mean square (RMS) error were significantly reduced following CL wearing in both fitting approaches (all  $p < 0.05$ ).

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**Conclusion:** Short-term rigid gas-permeable CL wear flattens the anterior cornea, increases the thinnest corneal thickness and reduces anterior surface HOA in keratoconus subjects. Apical-touch was associated with greater corneal flattening in comparison to three-point-touch lens wear.

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## PALABRAS CLAVE

Córnea;  
Queratocono;  
Lentes de contacto

## Cambios corneales a corto plazo con el uso de lentes de contacto permeables al gas en sujetos con queratocono: comparación entre dos procedimientos de adaptación

### Resumen

**Objetivo:** Evaluar los cambios en la topografía corneal anterior y las aberraciones de alto orden (HOA) a los 14 días de uso de lentes de contacto rígidas permeables al gas (RGP) en pacientes con queratocono, comparando dos tipos diferentes de adaptación.

**Métodos:** Se incluyó en el estudio a treinta y un sujetos con queratocono (50 ojos), sin historia previa de uso de lentes de contacto. A los sujetos se les aplicó aleatoriamente un procedimiento de adaptación de toque apical o de tres puntos. Radio base (BOZR) de la lente fue de 0,4 mm, y 0,1 mm más plano que las primeras lentes que proporcionaban claridad apical, respectivamente. Se compararon las diferencias entre la visita de inicio y tras el uso de las lentes, de las mediciones de potencia corneal media, en el meridiano más plano y más curvo, el astigmatismo central corneal (CCA), la curvatura tangencial máxima (KTag), la asfericidad de la superficie corneal anterior, las HOA de la superficie corneal anterior y el grosor corneal más fino, utilizando el sistema Pentacam.

**Resultados:** Se encontró un aplanamiento estadísticamente significativo en el tiempo, de las lecturas queratométricas más plana y más curva así como de la potencia media de la córnea, en el grupo de toque apical (todos  $p < 0,01$ ). Se detectó una reducción estadísticamente significativa de la KTag en ambos grupos tras el uso de lentes de contacto (todas las  $p < 0,05$ ). Se observó una reducción significativa en el tiempo del CCA ( $p = 0,001$ ) y de la asfericidad corneal anterior en ambos grupos ( $p < 0,001$ ). El grosor en el punto corneal más fino se incrementó considerablemente tras el uso de las lentes ( $p < 0,0001$ ). Se redujeron considerablemente el coma y el error cuadrático medio asociado a las HOA tras el uso de las lentes de contacto con ambos procedimientos de adaptación ( $p < 0,05$ ).

**Conclusión:** El uso de lentes de contacto rígidas permeables al gas aplanan la córnea anterior, incrementa el espesor del punto más fino de la córnea, y reduce las HOA de la superficie anterior en pacientes con queratocono. La adaptación de toque apical está asociada a un mayor aplanamiento de la córnea en comparación con la adaptación tres puntos.

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## Introduction

Corneal rigid gas-permeable (RGP) contact lenses still represent the most common and successful management option for mild to moderate cases of keratoconus because these lenses can mask relatively high levels of irregular astigmatism and thus substantially improve visual acuity.<sup>1</sup> Additionally, most keratoconus subjects report wearing these lenses comfortably throughout the day.<sup>1,2</sup>

Three fitting approaches have been described to fit corneal RGP in keratoconus: (1) apical-touch (lens bears on corneal apex), (2) three-point-touch (lens' bearing is shared between corneal apex and mid periphery), and (3) apical-clearance (lens bears on mid periphery without apical-touch).<sup>3</sup>

The use of corneal RGP contact lenses has been shown to induce topographical changes on the cornea in normal control subjects<sup>4,5</sup> as well as in subjects with keratoconus.<sup>6</sup>

In normal subjects, corneal curvature changes observed following RGP contact lens wear are related to the type of contact lens worn and the number of years of lens wear.<sup>5</sup> It has been reported that apical-touch fitting causes central corneal flattening in keratoconus,<sup>7</sup> whereas apical-clearance fitting causes central corneal steepening,<sup>8</sup> which could be confounded with the normal progression of keratoconus disease, so apical-clearance fitting approach is not normally used. Zadnik and Mutti<sup>9</sup> previously discussed that apical-touch fitting of RGP lenses might 'mold' the keratoconic cornea by exerting pressure on the cone apex, thereby forcing the anterior surface to conform with the RGP lens' back surface. Hwang et al. have reported RGP contact lens wear fitted with three-point-touch fitting approach in keratoconus subjects caused corneal flattening after two years of wear.<sup>2</sup> More recently, Jinabhai and co-workers reported that both visual acuity and thickness at the thinnest corneal point decreased and corneal curvature and corneal

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