The Visual Acuity Outcome, Rate of Rejection and Mean Intraocular Pressure Contrasted between PKP and DALK Techniques in a Sample of Iraqi Patients with Corneal Grafting

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ABSTRACT

Background: Penetrating keratoplasty (PKP), in which all the layers of the cornea are removed and replaced by the tissues obtained from a donor, remains for long time as the surgical method of choice in treating diseased cornea when medical approach fails. Because of graft rejection following PKP and associated post-operative complications there has been a change toward another technique known as the deep anterior lamellar keratoplasty (DALK) in which healthy tissue are retained and removal process will be restricted to disease tissue only leading to less immunological rejection.

Aim of the Study: the current study was planned and conducted in order to compare two groups of patients, PKP and DALK groups, in term of visual acuity, rate of rejection and intraocular pressure (IOP).

Patients and Methods: This case reference study was based on reviewing the available records of patients who underwent keratoplasty during the period extending from January 2014 through December 2019 in a single private center owned and directed by the author of the current study. The records were searched for age of patients at time of presentation, their gender, indication of operation, best corrected visual acuity, signs of graft rejection and intraocular pressure (IOP). The inclusion was based on collecting information for at least one year comprising 5 visits; each visit is 2 to 3 months apart.

Results: During the first, second and third visits, there was significant difference in the rate of good visual acuity (best corrected visual acuity BCVA ≥ 6/15) between PKP and DALK groups (P < 0.05); being higher in DALK group, 39.5% versus 13.8%, 42.1% versus 20.7% and 47.4% versus 24.1%, respectively. The rate of good visual acuity during the 4th and the 5th visits was also higher in DALK group in comparison with PKP group, 55.3% versus 34.5% and 68.4% versus 41.4%, respectively; however, the difference did not reach statistical significance as p-values were 0.057 and 0.073. In the 2nd, 3rd and 4th visits, there was no significant difference in the rate of rejection between both groups (P > 0.05); however, there was significant difference in the rate of rejection during the last visit (P = 0.046), being lower in the DALK group. There was no significant difference in mean IOP between PKP and DALK groups during all reviewed visits (P > 0.05).

Conclusion: our study has shown that DALK is superior to PKP because of less rate of rejection and better visual acuity results with lack of significant difference in post operative mean IOP.

KEY WORDS
visual acuity, rate of rejection, intraocular pressure, PKP, DALK, Iraq
There are a number of complications that have been described in association with PKP such as topical steroid use for a long period of time and its effect on the IOP, long time needed for visual rehabilitation and unpredictable astigmatism (Price and Price, 2006). Corneal graft failure may happen following PKP because of immunological reaction of the host against donor endothelial cells (Lass et al., 2008). Because of graft rejection following PKP and associated post-operative complications there has been a change toward another technique known as the lamellar keratoplasty. Figure 5 in which healthy tissue are retained (endothelium) and removal process will be restricted to disease tissue only leading to less immunological rejection; however, these new techniques need more complicated technical work with more operative time when compared to the old PKP procedure (Akanda et al., 2013; Cassidy et al., 2013; Croasdale et al., 2013).

Here in our country, little is known about how patients have got benefit from both types of operation and which operation offers better outcome in term of visual acuity and less rate of rejection or complications on long term basis; therefore, the current study was planned and conducted in order to compare two groups of patients, PKP and DALK groups, in term of visual acuity, rate of rejection and intraocular pressure (IOP) through the follow up period visits.
**Table 1: General characteristics of patients enrolled in the present study**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total n = 67</th>
<th>PKP group n = 29</th>
<th>DALK group n = 38</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Mean ± SD</td>
<td>29.79 ± 13.56</td>
<td>32.10 ± 15.05</td>
<td>28.01 ± 12.22</td>
<td>0.225 †</td>
</tr>
<tr>
<td>Range</td>
<td>11 -74</td>
<td>11 -73</td>
<td>11 -74</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>30 (44.8 %)</td>
<td>15 (51.7 %)</td>
<td>15 (39.5 %)</td>
<td>0.318 ‡</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>37 (55.2 %)</td>
<td>14 (48.3 %)</td>
<td>23 (60.5 %)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Eye</strong></td>
<td></td>
<td></td>
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<tr>
<td>Right (OD), n (%)</td>
<td>31 (46.3 %)</td>
<td>10 (34.5 %)</td>
<td>21 (55.3 %)</td>
<td>0.091 †</td>
</tr>
<tr>
<td>Left (OS), n (%)</td>
<td>36 (53.7 %)</td>
<td>19 (65.5 %)</td>
<td>17 (44.7 %)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Keratoconus, n (%)</td>
<td>57 (85.1 %)</td>
<td>21 (72.4 %)</td>
<td>36 (94.7 %)</td>
<td>References</td>
</tr>
<tr>
<td>Corneal dystrophy, n (%)</td>
<td>7 (10.4 %)</td>
<td>5 (17.2 %)</td>
<td>2 (5.3 %)</td>
<td>0.177 ‡</td>
</tr>
<tr>
<td>Graft failure, n (%)</td>
<td>3 (4.5 %)</td>
<td>3 (10.3 %)</td>
<td>0 (0.0 %)</td>
<td>NS</td>
</tr>
</tbody>
</table>

* n: number of cases; SD: standard deviation; PKP: Penetrating Keratoplasty; DALK: Deep anterior lamellar keratoplasty; OD: oculus dexter; OS: oculus sinister; † Independent samples t-test; ¥: Chi-square test; Y: Yates correction for continuity; NS: not significant at P > 0.05

**PATIENTS AND METHODS**

The current study was conducted in Al-Najaf province, mid-Euphrates region of Iraq during the period extending from September the 1st 2019 to February the 2th 2020. This case reference study was based on reviewing the available records of patients who underwent keratoplasty during the period extending from January 2014 through December 2019 in a single private center owned and directed by the author of the current study. The records were searched for age of patients at time of presentation, their gender, indication of operation, best corrected visual acuity, signs of graft rejection and intraocular pressure (IOP). The inclu--
sion was based on collecting information for at least one year comprising 5 visits; each visit is 2 to 3 months apart. Any record which did not fulfill these criteria was excluded from the study. At the end of the 67 reports were included, 29 of PKP and 38 of DALK techniques.

Ethically, the study was approved by the ethical approval committee of Kufa University. Faculty of Medicine and verbal consent was obtained from each patient by making a phone call.

The data were analyzed using SPSS (IBM, Chicago, USA, version 23). Qualitative data were expressed as number and percentage; whereas, quantitative data were expressed as mean, range and standard deviation. Independent samples t-test was used to compare means between two groups and One way analysis of variance and Variance ratio were used to study differences in proportion between two groups. The level of significance was chosen at $P \leq 0.05$.

## RESULTS

The general characteristics of patients enrolled in the current study were summarized in Table 1. As it was stated before, the study included a total of 67 patients who were categorized according to the type of corneal grafting operations into two groups. The first group included 29 patients who underwent PKP operation with a mean age of $32.10 \pm 15.05$ years and an age range of 11 - 74 years and the second group included 38 patients who were approached by DALK operation with a mean age of $28.03 \pm 12.22$ years and an age range of 11 - 74 years. There was no significant difference in mean age between both groups regarding mean age ($P = 0.057$); two other indications were recorded: corneal dystrophy and previous graft failure, Table 1.

The frequency of right eye (OD) was 31 and that of the left eye (OS) was 36, with lack of significant difference in the frequency distribution of patients according to side of eye between PKP and DALK groups ($P = 0.318$), as shown in Table 1. The principal indication was keratoconus which was seen in $57 \,(85.1\%)$ of $\geq 2$ cases and there no significant difference in the frequency distribution of patients according to indication between PKP and DALK groups ($P = 0.318$); two other indications were recorded: corneal dystrophy and previous graft failure, Table 1.

One of the major outcomes to evaluate the efficiency of PKP and DALK operations is the visual acuity. The visual acuity of patients enrolled in the current study was contrasted between both groups and were summarized in Table 2. During the first, second and third visits, there was a significant difference in the rate of good visual acuity (BCVA $\geq 6/15$) between PKP and DALK groups ($P < 0.05$), being higher in DALK group, $39.5\%$ versus $13.8\%$, $42.1\%$ versus $20.7\%$ and $47.4\%$ versus $24.1\%$, respectively. The rate of good visual acuity during the 4th and the 5th visits was also higher in DALK group in comparison with PKP group, $55.3\%$ versus $34.5\%$ and $68.4\%$ versus $41.4\%$, respectively; however, the difference did not reach statistical significance as $p$-values were 0.057 and 0.073, but these values are very close to the significance level of 0.05 and can be considered as borderline significant values. (Table 2)

Another important outcome was rejection rate which was outlined in Table 3. Indeed, the rate of rejection (endothelial rejection) was rang- ing from 10.3\% to 20.7\% in PKP group and form 2.6\% to 21.1\% in DALK group (stromal rejection). In the 2nd, 3rd and 4th visits, there was no significant difference in the rate of rejection between both groups ($P > 0.05$); however, there was significant difference in the rate of rejection during the last visit ($P = 0.046$), being lower in the DALK group, as shown in Table 3.

Finally, intraocular pressure (IOP) was the last outcome included in the current study and its mean is shown in Table 5. Actually, there was no significant difference in mean IOP between PKP and DALK groups during all reviewed visits ($P > 0.05$), as shown in Table 4.

## DISCUSSION

Corneal grafting is a relatively new technique that has been introduced to ophthalmic clinical practice in Iraq, particularly in the mid-Euphrates region. Indeed, most patients were subjected to these operations outside the country until recently. Here in Al-Najaf province, two types of techniques were practiced since 2014 and a good pool of patients has registered records in our private center. In order to compare PKP grafting technique to DALK grafting technique, we reviewed the records of 67 patients since 2014 till time of conducting this paper.

DALK appear to be better than PKP in terms of significantly better visual acuity and less rate of rejection. In addition, there was no significant difference in mean IOP between both groups during all period of follow up. One on meta-analysis studies has shown that the rate of rejection was higher in PKP in comparison with lamellar type operations (Akanda et al., 2013). The most acceptable explanation for the less rate of rejection cause by DALK operation may be in the form of lack of donor endothelial cells and lack of cells in the stromal tissue (merely collagen fibers) and less removal of host tissue leading to less immune response and less inflammatory reaction in case of lamellar types operation in comparison with full thickness grafts (Akanda et al., 2013; Price et al., 2013).

In our study, the best corrected visual acuity (BCVA) of DALK patients was significantly better than that of PKP patients in accordance with the finding of a previous meta-analysis study (Liu et al., 2015). A number of previous reports have contrasted PKP versus DALK with respect to visual acuity with conflicting results (Fontana et al., 2007; Al-Torbak et al., 2006; Fogla and Padmanabhan, 2006). Some authors have shown, in contrary to our results, that DALK is associated with poorer visual acuity in comparison to PKP operation (Fogla and Padmanabhan, 2006; Benson et al., 1993; Archila, 1984). On the other hand, other authors have shown that there was no significant difference in the good visual acuity when DALK was contrasted to PKP (Saini et al., 2003; Coombes et al., 2001; Sugita and Kondo, 1997). Variation in technical skills may be one possible explanation to variation in visual acuity in different studies.

## CONCLUSION

In conclusion, our study has shown that DALK is superior to PKP because of technically more stable globe (presence of Descemet’s membrane and endothelium) so suturing stability will play apart in such stable globe, less rate of rejection (merely stromal rejection which is less effective on graft survival) and better visual acuity results with lack of significant difference in post operative mean IOP.

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## REFERENCES


