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Coordinación mano-ojo con visión indirecta identificada mediante los dispositivos DIVIN y TrazaCav

Hand-eye coordination with indirect vision identified by DIVIN and TrazaCav devices

Coordenação mão-olho com visão indireta identificada através dos dispositivos DIVIN e TrazaCav

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Resumen

La capacidad de coordinación mano-ojo con visión indirecta (CMOVI) es imprescindible en la práctica odontológica, pues de ella depende el acceso visual para maniobrar en regiones recónditas de la boca sin comprometer los principios ergonómicos. El objetivo de esta investigación es establecer si los dispositivos *DIVIN* y *TrazaCav* son útiles para identificar esa coordinación en aspirantes a ingresar al programa de Médico Cirujano Dentista (MCD) de la Unidad Académica de Odontología de la UAZ (UAO/UAZ). Para ello se realizó un estudio transversal experimental en una muestra aleatoria estratificada (n=169) de aspirantes a la UAO/UAZ, promociones 2014 a 2016. Cada sujeto ejecutó tres ejercicios de CMOVI, empleando el *DIVIN* y el *TrazaCav*, considerando tres categorías: *precisión en el perfilado*, *profundidad en el trazado* y *tiempo empleado*, evaluados por tres expertos. Los resultados, concentrados en cédula de registro, se sometieron a descripción de frecuencias y medidas de tendencia central. Los resultados fueron: 19 estudiantes ubicados en promedio general de 6.0 (sobre una base de 10), 16 en 5.3, 15 en 5.7 y 14 en 7.0, el resto se distribuye sin un patrón uniforme en las posibilidades restantes. En precisión en perfilado, 34 obtuvieron 1.7 de calificación (sobre una base de 4.0), 32 con 2.0 y 24 con 2.3. En profundidad en trazado, 31 se ubican en 2.3 de calificación (sobre una base de 4.0), 27 en 2.7 y 25 en 2.0. En tiempo empleado, 116 se agrupan en 2.0 de calificación (sobre una base de 2.0), 28 en 1.0 y 10 en 1.7. Las calificaciones son similares en cada edición, encontrándose mayor diferencia en 2015, con un ligero incremento en las de precisión y profundidad. En conclusión, se evidencia la utilidad del *DIVIN* y *TrazaCav* para identificar la CMOVI en aspirantes a MCD, dadas las constantes encontradas en cada una de las ediciones del curso propedéutico de esta institución.

Palabras clave: coordinación mano-ojo, dispositivos de visión indirecta, curso propedéutico, perfil de ingreso.

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Abstract

The ability of hand-eye coordination with indirect vision (CMOVI) is essential in dental practice, since it depends on visual access to maneuver in remote regions of the mouth without compromising ergonomic principles. The objective of this research is to establish if the DIVIN and TrazaCav devices are useful to identify this coordination in applicants to enter the Dentist Surgeon (MDC) program of the Academic Unit of Dentistry of the UAZ (UAO / UAZ). For this, an experimental cross-sectional study was carried out in a stratified random sample (n = 169) of aspiring UAO / UAZ, promotions 2014 to 2016. Each subject executed three CMOVI exercises, using the DIVIN and the TrazaCav, considering three categories: precision in profiling, depth in the layout and time spent, evaluated by three experts. The results, concentrated in the registration card, were subjected to description of frequencies and measures of central tendency. The results were: 19 students located in general average of 6.0 (on a base of 10), 16 in 5.3, 15 in 5.7 and 14 in 7.0, the rest is distributed without a uniform pattern in the remaining possibilities. In precision in profiling, 34 obtained 1.7 of qualification (on a base of 4.0), 32 with 2.0 and 24 with 2.3. In depth in layout, 31 are located in 2.3 rating (on a 4.0 basis), 27 in 2.7 and 25 in 2.0. In time employed, 116 are grouped into 2.0 rating (on a 2.0 basis), 28 in 1.0 and 10 in 1.7. The ratings are similar in each edition, with a greater difference in 2015, with a slight increase in accuracy and depth. In conclusion, the usefulness of the DIVIN and TrazaCav to identify the CMOVI in aspiring DCM is evident, given the constants found in each one of the editions of the preparatory course of this institution.

Key words: hand-eye coordination, indirect vision devices, preparatory course, entry profile.

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Resumo

A capacidade de coordenação mão-olho com visão indireta (CMOVI) é essencial na prática odontológica, pois depende do acesso visual para manobrar nas regiões remotas da boca sem comprometer os princípios ergonômicos. O objetivo desta pesquisa é estabelecer se os dispositivos DIVIN e TrazaCav são úteis para identificar esta coordenação na aspiração de entrar no cirurgião dentista (MDC) da Unidade Acadêmica de Odontologia do UAZ (UAO / UAZ). Para isso, um estudo transversal experimental foi realizado em uma amostra aleatória estratificada (n = 169) das aspirantes a UAO / UAZ, promoções 2014 a 2016. Cada sujeito executou três exercícios de CMOVI, usando DIVIN e TrazaCav, considerando três categorias: precisão no perfil, profundidade no layout e tempo gasto, avaliada por três especialistas. Os resultados, concentrados no cartão de registro, foram submetidos à descrição de freqüências e medidas de tendência central. Os resultados foram: 19 estudantes localizados em média geral de 6.0 (em uma base de 10), 16 em 5.3, 15 em 5.7 e 14 em 7.0, o resto é distribuído sem um padrão uniforme nas demais possibilidades. Com precisão em perfis, 34 obtiveram 1.7 de qualificação (em base de 4.0), 32 com 2.0 e 24 com 2.3. Em profundidade no layout, 31 estão localizados em 2.3 classificação (em 4.0 base), 27 em 2.7 e 25 em 2.0. Com o tempo empregado, 116 são agrupados em classificação 2.0 (2.0), 28 em 1,0 e 10 em 1,7. As classificações são semelhantes em cada edição, com uma maior diferença em 2015, com um ligeiro aumento na precisão e profundidade. Em conclusão, a utilidade do DIVIN e TrazaCav para identificar o CMOVI no aspirante a DCM é evidente, dadas as constantes encontradas em cada uma das edições do curso preparatório desta instituição.

Palavras-chave: coordenação mão-olho, dispositivos para visão indireta, curso propedêutico, perfil de renda.

Fecha Recepción: Febrero 2017 **Fecha Aceptación:** Julio 2017

Introduction

The ability of hand-eye coordination with indirect vision (CCMOVI) is essential in dental practice, since it depends on the possibility of having visual access and maneuvering in remote regions of the oral cavity unattainable for direct vision without compromising the principles of ergonomics.

Since the beginning of the last century, this skill began to be given importance, but it was not until the beginning of the eighties of that same period that interest in identifying it and promoting its development arose. In this stage appeared the first devices created for this purpose, which over time became more sophisticated until reaching the current haptic or augmented reality simulators.

The context of the present study has to do with the devices developed before the digital age. The first reference was made by Wiegmann (1983), who published the use of a training plate with shapes, measurements and surface engravings for preclinical habilitation combined with correct postural control in the use of rotating instruments, working with indirect image through a mirror and a barrier system using a Plexiglas screen. Another preclinical function plate proposed at the University of Utrech, Holland, consisted of a series of layers similar to the dental arches, which allowed its adaptation to a plastic box, which in turn was adapted to training mannequins; In addition, the shape and size of the strokes were very close to real situations. This set was popularized with the name of Resopal Jaw (Carrillo, 1992).

In the Faculty of Dentistry of Madrid, according to Carrillo (1992), a primitive acrylic plate was used whose traces used in shape and size correspond to the preparations that are made in the dental clinic, in addition to having an apparent order that could relate to a greater or lesser degree of difficulty in the exercises performed on them.

Parallel to the development of the plates, Neumann (1988), at the University of Illinois (Chicago), has used plates with drawings susceptible to be subject to artificial dental arches. In them the use of indirect vision with a dental mirror is required to follow drawings through a contra-angle that uses a graphite mine instead of a strawberry.

These same plates have been modernized with the passage of time to become the systems produced in series that are now known as Learn-A-Prep. The device basically consists of a hand piece and acrylic plates of three layers of different colors, mounted in a kind of hinge-type articulator, where preparations of cavities are made for operation.

In this regard, Jones (1974) and Neumann (1988) are in favor of using conventional dental mirrors for the preclinical exercises of indirect vision; in this way, the movements of the hands and fingers to achieve this vision are very similar to those used in the usual dental operative tasks, being more operative than those used in the boxes of indirect vision.

Jones (1974) also used the dental hand mirror to perform indirect vision training in a built-in electric circuit on the teeth of an archway where, in the occlusal plane of the tooth, a class I cavity is drawn, in which the student You must follow the profile with a probe connected to the circuit. When the probe leaves the said profile it makes contact with the metallic peripheral mechanism, registering the error.

More recently, Rau and Rau (2011) proposed indirect vision practices with the Mirrorprep (figure 1). It is a device developed from a metal plate with four folds to prevent a direct view on the floor of the box that is created, which is only accessible through a mirror placed on the inside of the box that reflects the floor. To this unit is added a handpiece simulator where a pencil that acts as the strawberry is inserted. This is intended to make the student perform indirect vision on a piece of paper where different images are printed.

Figure 1. Práctica de visión indirecta con el *Mirrorprep*.

Source: Tomado de RAU, Günter M. & Rau, Anne K. (2011).

With respect to research to establish the usefulness of these devices, it is interesting to highlight some studies that are directly linked to the creators themselves. In this sense, Carrillo (1992) worked with 40 students of the Faculty of Dentistry of the Complutense University of Madrid, divided at random into two groups to determine the existence of learning indirect vision skills, through a box designed for that purpose. The exercises developed by the students consisted of moving objects with tweezers and carving cavities. The author concludes that indirect vision is a skill susceptible of being learned in certain circumstances and transferable to others, but that it can not be assured that such ability improves the results in the real dental clinic.

On the other hand, the study by Díaz et al. (2001) also aimed to evaluate a preclinical training system with indirect vision for dental education, where the population studied were students aged 18 to 20 years, at the beginning of their first dental course. The design involved two sessions separated by a seven-day interval in which the students used a reflection box to develop psychomotor skills in the use of the mirror. The exercises consisted of following a curved, straight or spiral form in the reflection box. Four groups of students trained in different ways by curved or straight lines were observed. The results after the first training session were statistically significant, while the improvement was not significant after the second work session. Those students who trained first with curved lines and then with straight

lines produced more errors than the other groups. Women performed better than men in this evaluation. This research does not include translating into clinical work itself.

Finally, Rau and Rau, (2011) explored whether the ability of precise movements inverted by mirror can be learned and improved with the device designed by them -the Mirroprep- and if the success of the practice can be transferred to the clinical situation. Three groups of dentistry students in different levels of study and achievement levels had to perform a drawing exercise with indirect vision using Mirroprep. The results of the test showed that inverted mirror motility can be learned and improved by practice and that it is also useful for making tooth preparations. For 40% of students, the device was very helpful in transferring what was learned to real mouths. With this, the authors consider it reasonable for students to begin practicing with the training device during preclinical studies to develop their skills. Variations on this simulator can be found in multiple articles.

On the other hand, although it is true that the coordination referred to can be trained in any subject, it is also true that the earlier the degree that each one possesses is recognized, the sooner the actions tending to its improvement can be arranged.

Under this premise, the present study is aimed at establishing whether the DIVIN and TrazaCav devices -developed in the UAO / UAZ by the authors- are useful to identify, from the expert's perception, the degree of hand-eye coordination with vision indirect in aspiring to enter the UAO / UAZ.

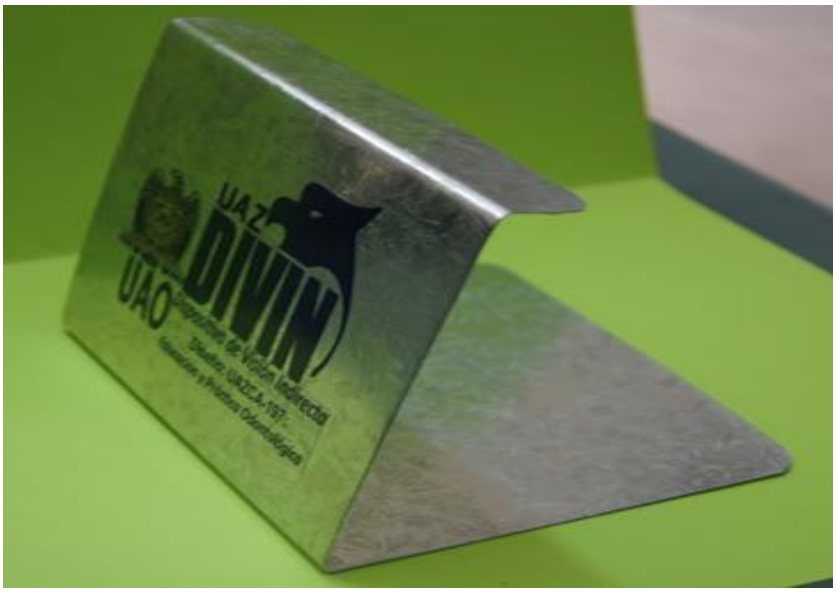
Objective

Establish whether the DIVIN and TrazaCav devices are useful to identify, based on the perception of experts, the degree of hand-eye coordination with indirect vision in applicants to the UAO / UAZ.

Method

An experimental cross-sectional study was conducted in a sample of applicants to enter the program of Dentist Surgeon of the UAO / UAZ in the 2014, 2015 and 2016 promotions. The sample size was determined from the stratified random method with a level of 95% confidence, being constituted by 50 individuals for the 2014 stratum, 58 for 2015 and 61 for 2016. Each subject was asked to perform three hand-eye coordination exercises with indirect vision, using the DIVIN, the TrazaCav and a conventional dental mirror No. 5. The first is a device for indirect metallic vision (22-gauge smooth galvanized sheet, with a zinc coating of 275 gr / m2) of three planes, where the second one has a sheet printed in color with images of dental cavities; the first plane measures 2X13.5 cm, the second and third measure 11.5X13.5 cm (Figures 2 and 3), while the other is a cavity tracer device, made of plastic with obtuse angulation at 125 °, with a embedded graphite mine 2 cm long, emulating a dental bur, with measures of 9.5X1 cm in its handle and 1X0.5 cm in the active part (Figure 4).

Figure 2. Dispositivo de visión indirecta (*DIVIN*) de la UAO/UAZ en vista lateral.



Fuente: Fotografía de archivo de los autores.

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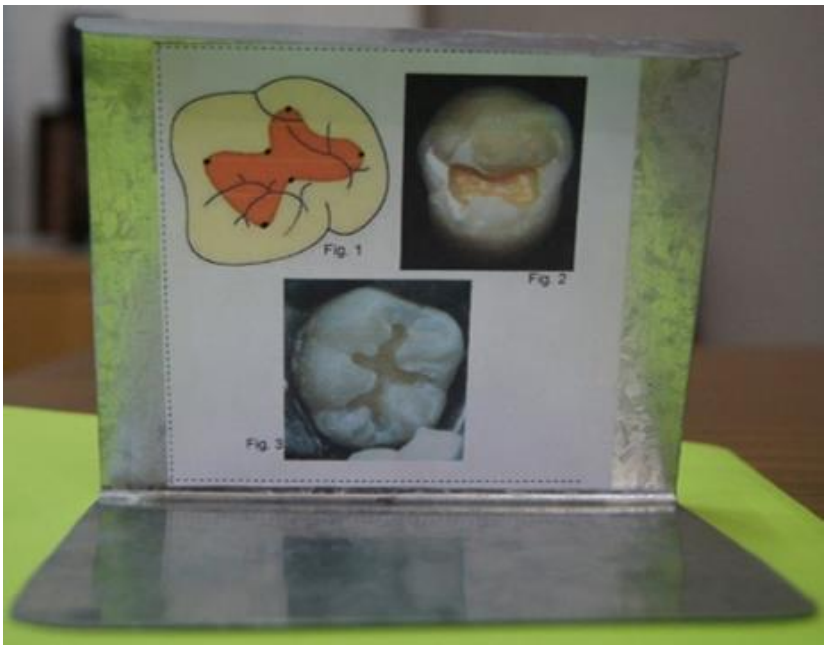
Figure 3. Dispositivo de visión indirecta (*DIVIN*) de la UAO/UAZ en vista del plano interno.



Fuente: Fotografías de archivo de los autores.

Figure 4. Dispositivo trazador de cavidades (*TrazaCav*) de la UAO/UAZ.

Fuente: Fotografía de archivo de los autores.

For the development of the activity the following order was considered:

1) Union of the points indicated with straight lines based on the peripheral contour of the diagram.
2) Complete filling of the drawn cavity.
3) Delineation of the outline of the cavity drawn.

Previously, the principles to be taken into account during the exercises were established, given the total lack of knowledge about the subject by the participants. These principles are:

1. All dental instruments when inserted into the oral cavity must have support provided by the hand supported by a stable surface.
2. 2. The carving of cavities supposes both precision and strength in the follow-up of a mentally preconceived design.
3. 3. Ergonomics requires in all dental treatment to maintain a comfortable and upright posture, based on the allegory of the dial of the watch, where 12 o'clock is the most suitable position for the operator in the upper jaw, taking as reference the patient's head.

For its part, the instructions indicated were:

- Sit upright in front of the DIVIN, take the dental mirror with the left hand (or right if you are left-handed) and with the other the TrazaCav.
- Locate with the mirror the three diagrams arranged in the DIVIN.
- Begin to perform the exercises with the TrazaCav according to the order indicated.

The positioning of the applicant in front of the devices is shown in figure 5.

Figure 5. Aspirante realizando los ejercicios de visión indirecta con el *DIVIN*, el *TrazaCav* y espejo dental convencional.

Source: Fotografía de archivo de los autores.

Once the activity was finished, three experts in cavity design evaluated the traces made by the applicants, considering the criteria that are set forth below:

- Precision in profiling (4 points)
- Depth in the layout (4 points)
- Time used, over a maximum of 6 minutes (2 points)

Finally, the information derived from the evaluation was concentrated on the exprofessionally constructed registration card, whose content was subjected to description of frequencies (relative and accumulated), as well as measures of central tendency.

Results

The results of the application of the DIVIN and TrazaCav devices were expressed in ratings given by three experts according to the three criteria included, namely: precision in profiling, depth in the layout and time used; whose averages are shown below in the following tables and figures.

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Table 1. Calificación promedio obtenida por los aspirantes a ingresar a la UAO en los ejercicios de visión indirecta en los tres años estudiados.

Calificación	Frecuencia	Porcentaje	Porcentaje válido	Porcentaje acumulado
0.00	2	1.2	1.2	1.2
1.30	1	0.6	0.6	1.8
2.30	1	0.6	0.6	2.4
3.00	1	0.6	0.6	3.0
3.30	3	1.8	1.8	4.7
3.70	2	1.2	1.2	5.9
4.00	2	1.2	1.2	7.1
4.30	5	3.0	3.0	10.1
4.70	4	2.4	2.4	12.4
5.00	13	7.7	7.7	20.1
5.30	16	9.5	9.5	29.6
5.70	15	8.9	8.9	38.5
6.00	19	11.2	11.2	49.7
6.30	13	7.7	7.7	57.4
6.70	11	6.5	6.5	63.9
7.00	14	8.3	8.3	72.2
7.30	10	5.9	5.9	78.1
7.70	10	5.9	5.9	84.0
8.00	8	4.7	4.7	88.8
8.30	7	4.1	4.1	92.9
8.70	5	3.0	3.0	95.9
9.00	4	2.4	2.4	98.2
9.30	1	0.6	0.6	98.8
9.70	2	1.2	1.2	100.0
Total	169	100.0	100.0	

Source: elaboración con base en datos propios.

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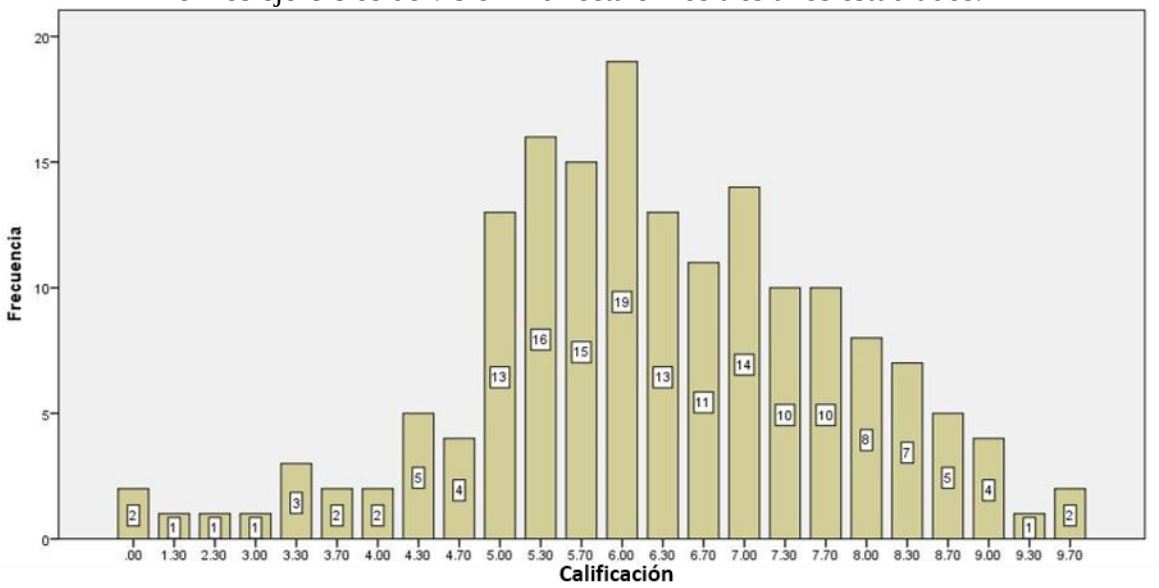
Figure 5. Calificación promedio obtenida por los aspirantes a ingresar a la UAO en los ejercicios de visión indirecta en los tres años estudiados.



Source: elaboración con base en datos propios.

Table 1 and Figure 5 show that most of the candidates (19) are located in the general average of 6.0, 16 in 5.3, 15 in 5.7 and 14 in 7.0, while the rest is distributed without a uniform pattern to Through all the possibilities.

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Table 2. Puntaje obtenido por los aspirantes a ingresar a la UAO en la categoría *precisión en el perfilado* de los ejercicios de visión indirecta en los tres años estudiados.

Puntaje	Frecuencia	Porcentaje	Porcentaje válido	Porcentaje acumulado
0.00	3	1.8	1.8	1.8
0.30	1	0.6	0.6	2.4
0.70	8	4.7	4.7	7.1
1.00	7	4.1	4.1	11.2
1.30	18	10.7	10.7	21.9
1.70	34	20.1	20.1	42.0
2.00	32	18.9	18.9	60.9
2.30	24	14.2	14.2	75.1
2.70	16	9.5	9.5	84.6
3.00	16	9.5	9.5	94.1
3.30	7	4.1	4.1	98.2
3.70	3	1.8	1.8	100.0
Total	169	100.0	100.0	

Source: elaboración con base en datos propios.

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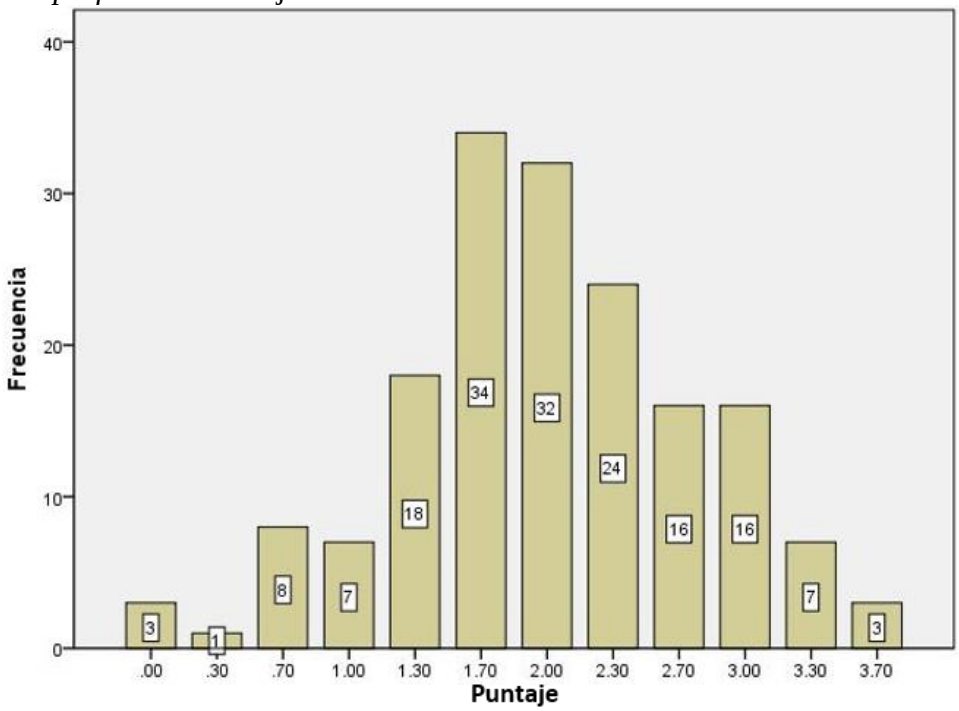
Figure 6. Puntaje obtenido por los aspirantes a ingresar a la UAO en la categoría *precisión en el perfilado* de los ejercicios de visión indirecta en los tres años estudiados.



Source: elaboración con base en datos propios.

Considering only the first of the categories, the majority of the participants (34) obtained 1.7 of qualification, followed by 32 with 2.0 and 24 with 2.3; while the others are located at the minimum and maximum extremes, as shown in table 2 and figure 6.

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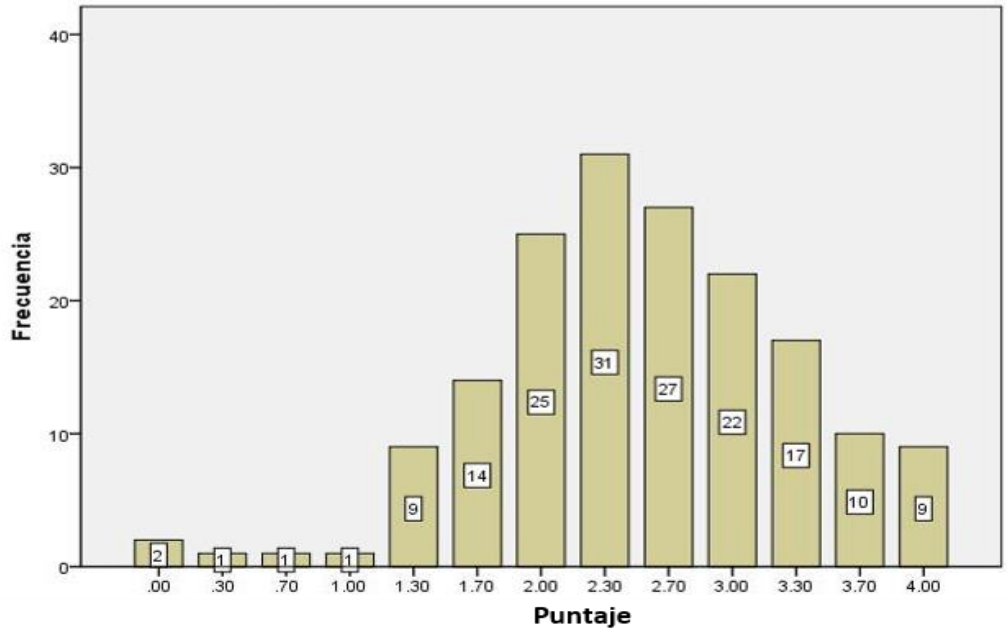
Table 3. Puntaje obtenido por los aspirantes a ingresar a la UAO en la categoría *profundidad en el trazado* de los ejercicios de visión indirecta en los tres años estudiados.

Puntaje	Frecuencia	Porcentaje	Porcentaje válido	Porcentaje acumulado
0.00	2	1.2	1.2	1.2
0.30	1	0.6	0.6	1.8
0.70	1	0.6	0.6	2.4
1.00	1	0.6	0.6	3.0
1.30	9	5.3	5.3	8.3
1.70	14	8.3	8.3	16.6
2.00	25	14.8	14.8	31.4
2.30	31	18.3	18.3	49.7
2.70	27	16.0	16.0	65.7
3.00	22	13.0	13.0	78.7
3.30	17	10.1	10.1	88.8
3.70	10	5.9	5.9	94.7
4.00	9	5.3	5.3	100.0
Total	169	100.0	100.0	

Source: elaboración con base en datos propios.

Figure 7. Puntaje obtenido por los aspirantes a ingresar a la UAO en la categoría *profundidad en el trazado* de los ejercicios de visión indirecta en los tres años estudiados.



Source: elaboración con base en datos propios.

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As regards the second category, the largest number (31) is located in 2.3 of qualification, followed by 27 in 2.7 and 25 in 2.0; while the rest of the sample is distributed in the other probabilities; which can be observed more clearly in table 3 and figure 7.

Table 4. Tiempo empleado por los aspirantes a ingresar a la UAO para la realización de los ejercicios de visión indirecta en los tres años estudiados.

Puntaje	Frecuencia	Porcentaje	Porcentaje válido	Porcentaje acumulado
0.00	4	2.4	2.4	2.4
0.70	2	1.2	1.2	3.6
1.00	28	16.6	16.6	20.1
1.30	9	5.3	5.3	25.4
1.70	10	5.9	5.9	31.4
2.00	116	68.6	68.6	100.0
Total	169	100.0	100.0	

Source: elaboración con base en datos propios.

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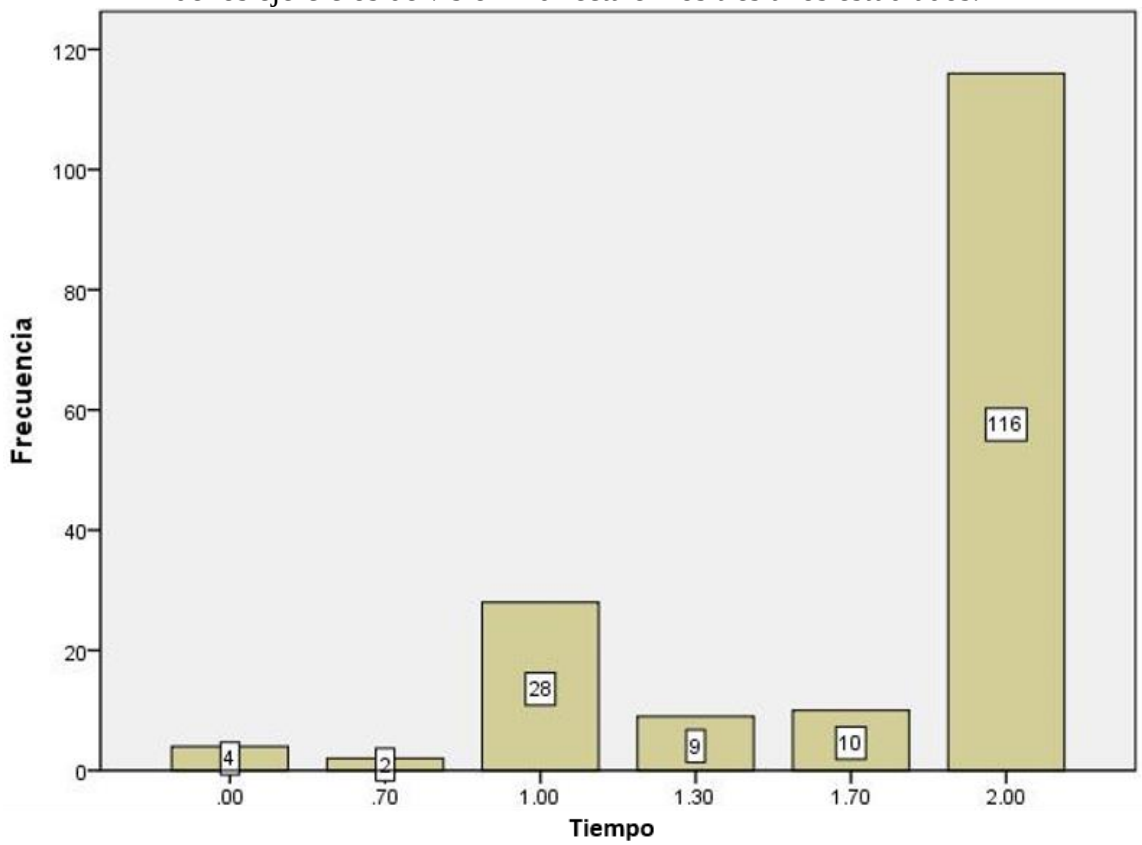
Figure 8. Tiempo empleado por los aspirantes a ingresar a la UAO para la realización de los ejercicios de visión indirecta en los tres años estudiados.



Source: elaboración con base en datos propios.

With regard to the third category, the vast majority (116) is grouped in 2.0 qualification, followed by 28 in 1.0 and 10 in 1.7; the rest is in the other remaining possibilities, as shown in table 4 and figure 8.

The behavior of the qualifications is similar if each one of the editions is considered separately, being the biggest difference in the course 2015, where a slight increase in the grades of precision and depth can be appreciated. This situation is clearly evident in Figure 9, where the accumulated frequencies of the averages obtained by the applicants are compared.

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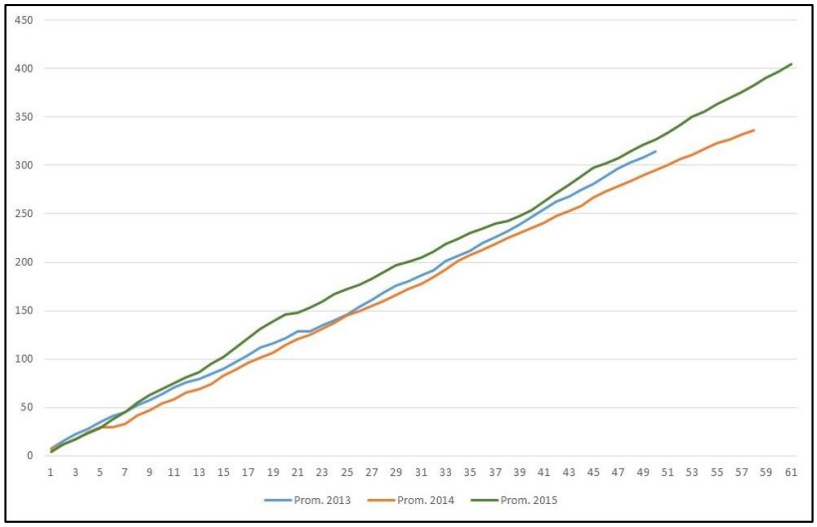
Figure 9. Comparativo de las frecuencias acumuladas de los promedios obtenidos por los aspirantes a ingresar a la UAO en los ejercicios de visión indirecta de los tres años estudiados.



Source: elaboración con base en datos propios.

On the other hand, breaking down the data by sex of the participants shows that both the precision in the profiling and the depth in the layout show that women perform better than men, which can be seen in the following figures.

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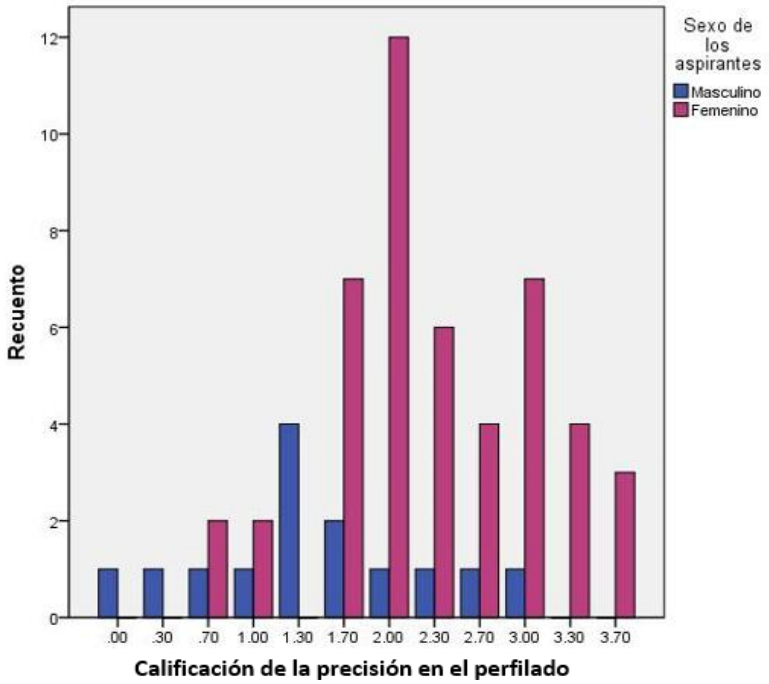
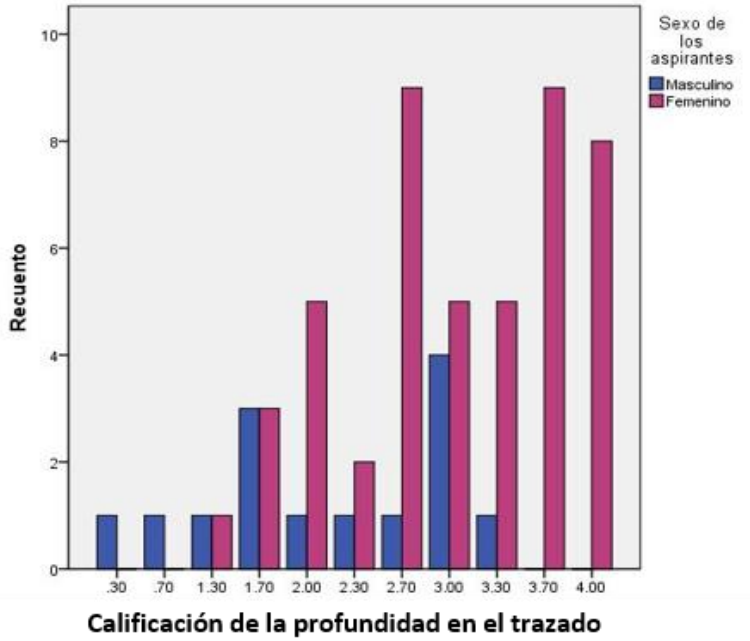
Figure 10. Calificación obtenida por los aspirantes a ingresar a la UAO en la variable precisión en el perfilado en los ejercicios de visión indirecta de los tres años estudiados, por sexo.



Source: elaboración con base en datos propios.

Figure 11. Calificación obtenida por los aspirantes a ingresar a la UAO en la variable profundidad en el trazado en los ejercicios de visión indirecta de los tres años estudiados, por sexo.



Source: elaboración con base en datos propios.

Discussion

Indirect vision is a very common practice in the dental practice in any of its specialties. It is an essential activity to have visual access to recondite areas of the oral cavity.

Therefore, learning indirect vision is obviously necessary in dentistry. For this purpose, devices have been designed that use mirrors and are used outside the mouth of the patient or the manikin to serve as preclinical training or to identify the degree of hand-eye coordination that has the career aspirant or student of the first degrees. The devices used in this study are an example of this and represent the scope of the research, since it focuses exclusively on its power to identify the ability to coordinate the hand with the eye through a mirror.

In this respect, the results found here coincide with Carrillo (1992) in the sense that some skills learned with indirect vision devices can be transferred to the clinic, but others can not. However, they are in contrast with what Rau and Rau (2011) have expressed, who assure that all skills can be transferred to clinical practice.

Likewise, they coincide with the findings of Díaz et al. (2001), who established the best performance of women over men in indirect vision exercises, because the same situation is repeated in this study.

Finally, although the research highlights the abilities of applicants to enter the Bachelor of Dentist Surgeon in the variables included, it also shows the impossibility of predicting if the deficiencies found in each one can be corrected in the immediate future.

Conclusions

Many devices have been created for the purpose of recording the ability to coordinate the hand with the eye by using a mirror, from the very simple and inexpensive, to the most sophisticated and expensive. The fact is that they are not always considered in all dentistry training institutions, especially in Latin America, where the recognition of the indicated capacity does not seem to have gained enough importance; hence the need to develop studies such as this that account for the benefit of artifacts created for that purpose.

Based on the results described, the usefulness of the DIVIN and TrazaCav devices is demonstrated to identify the hand-eye coordination capacity with indirect vision in the applicants to enter the Bachelor of Dentist Surgeon, given the constants found in each one of them. the editions of the propaedeutic course of this institution.

This utility does not come only from the certainty that both devices allow the identified capacity to be identified, but also from the fact that its manufacture is very simple and its cost extremely accessible; issues both that place them within reach of any institution since they can be manufactured by the professors themselves, as happens with those used in this study, which were designed and developed by the authors.

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