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The Kinematical Schemes Variants for Oriented Modules of the Dental Instruments*

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1. Introduction

The dental instruments involve a lot of many tools, by the help of which the dentist manipulate the tooth and the gum. The part of which is used only for manipulation without cutting and removing tooth material. The other part of them are special dental tools, which have motor, most frequently by pneumatically or electrical and with the rotating big speed cutting instrument which clears and prepare the tooth's surface for future treatment and medical cure. The kinds of instruments are the object for investigation in that article. The construction for good appliance into working zone which shape is space and complexity, and to the tooth, which have to manipulate is also. The problem is significant, because that surface is difficulty accessible and difficulty visible, but the quality to manipulating is very important for the successfully medical treatment. The actuality consist of nowadays development of the practice techniques which allows to apply many things like local lighting into the working zone [2], technical visualization on the working surface and the way of the cutting tool, while boring and manipulating surface along the deep of the tooth [4]. Beside that there are possibility and end expedient technical decision for flexibility and adaptation of the dental instrument construction.

Nowadays the shape of the dental instruments is that they are in, almost all cases, like straight cylinder with the declination of the axis from 18° till 20° part that holding the cutting tool. That form is most of all convenience for the dentist to catch and hold of the tool. In some cases [6] tools have more complexity shape and angle of 120° between the axis of the cutting tool and the axis of the holder which usually is 90°.

The problem which is not decided that is the smoothly, during the manipulation, positioning of the cutting head, where are built the pneumatic turbine and the cutting tool.

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The aim in that investigation is to be specifying the limit borderline of dimension and shape of the working zone, in which the dental instrument must to settle on precisely definite angle relating tooth surface, which will manipulate and the possibilities for flexible position to the object of work.

2. The method of investigation

The method of investigation is based mainly on two obliged steps. The first of them determine the shape and the dimension of the working zone. The second one analyzes the variants for kinematical schemes of the mechanism for supple positioning of the head of dental tool.

2.1. The determination of the working zone

The working zone of the dental tool can be dividing into two parts: outer and inner. The outer one is that in which must to be position the head of the tool with cutting tool together, when manipulate the outer surfaces on the below and above tooth. That working zone define mainly for the back and for the masticate tooth, elasticity of the soft texture of the patient's cheeks. So that any concrete dimension to specify is difficult.

More important is research and the definition maximal precisely inner working zone. It is defined from the inner surface of the tooth, tongue and the arc of the above tooth till the palate and the possibilities the maxillas to be open on definite angle. (Fig. 1).

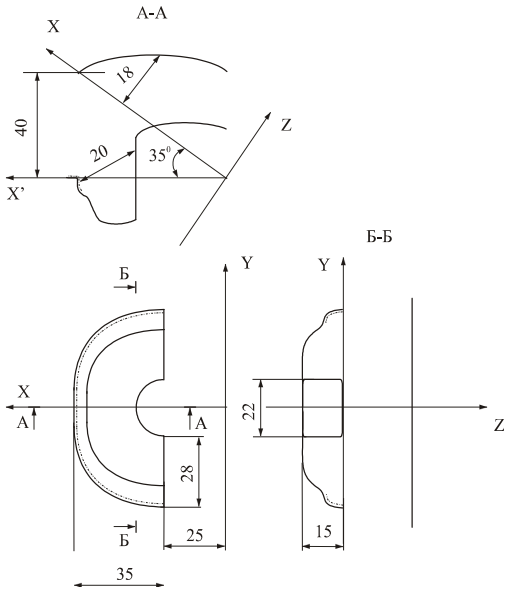

Fig. 1. The inner working zone of the dental tool

On Fig. 1 are showed sections to two mutually perpendicular plains and look above on the below maxilla. The coordinate system is based on the axis through the left and the right maxilla joints. Axis *X* is the central axis of masticates above tooth's

line axis Y is on the axis of the joints and axis Z is perpendicular toward the plain defining axis X and Y. The sections and dimensions is made how is showed (Fig. 1) on the below maxilla by the help of section plaints A-A, B-B They give imagination for the most remote border of the working zone. The line break with two point's show the contours on which the cutting tool is positioning. The value of dimensions is approximately. They are measured from the adult women and for male have to increase within the 15% till 25%. In spite of that they are very near by the given one in [7] for orthogonal projection for below and above maxilla.

2.2. The variants for kinematical schemes for mechanism soft positioning the cutting tool

The variant is chosen for kinematical schemes for mechanism to be built in dental instrument for soft positioning, in spice the working zone, under attention must to take the limit size of the most usual in practice tools [2, 6]. The two most distributed kinds of tools with pneumatic and electric drive are given on Fig. 2.

The soft positioning of the cutting tool is possible by the help of mechanism, which change the angle between the axis of the head, which hold the cutting tool, and the axis of the whole dental instrument (Fig. 2).

The classical decision is with spherical joint (Fig. 3), but there are disadvantage for moving toward the cutting tool the spout of air under pressure can not to be transferred.

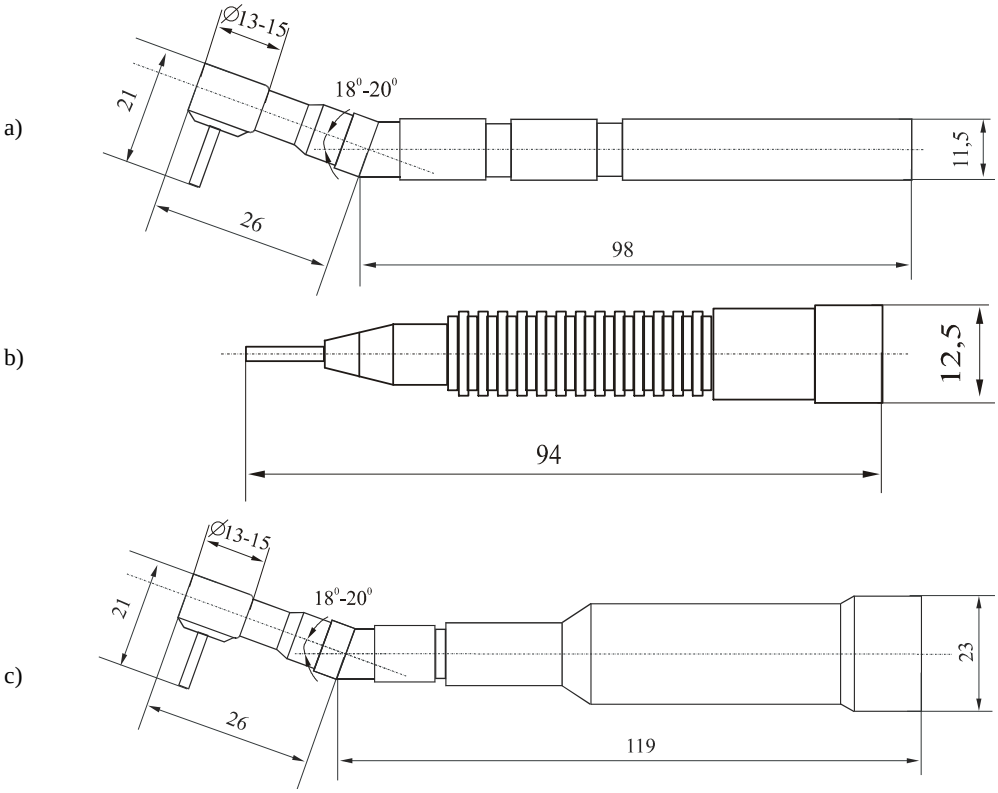

Fig. 2. The standard sizes of the dental instruments, driven: a) by pneumonic turbine with declination; b) by pneumonic turbine without declination; c) by electrical motor

That problem can be decided with joint which consist of protuberant spherical surface through which to be passed soft air pipe (Fig. 4).

The motion for rotating will realize by four link bar mechanism. It builds in four mechanisms situated across from each other via 90° then the tool head will receive spherical movement, i.e. rotation which will be into two mutual perpendicular directions. The axial rotation of the whole instrument from the dentist's hand is added and the full useful in kinematical relation tool is obtained.

It was examining the variants for some four bar mechanism: mechanism with screw kinematical joint; mechanism with translation kinematical joint driven by the pressure air (Fig. 5); mechanism with elastic links [1].

The variant. shown on Fig. 5, is for positioning the head in one plain, i.e. he movement produce two identical across setting mechanisms. That decision give satisfaction, because when is added the axial rotating from the dentist's hand precisely positions toward tooth is enough good.

From the three examine variant this one on the Fig. 5 is most good, because is received movement from the pressure air which working liquid for rotation motion of the cutting tool.

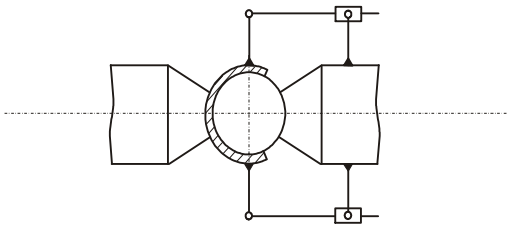

Fig. 3. The spherical joint

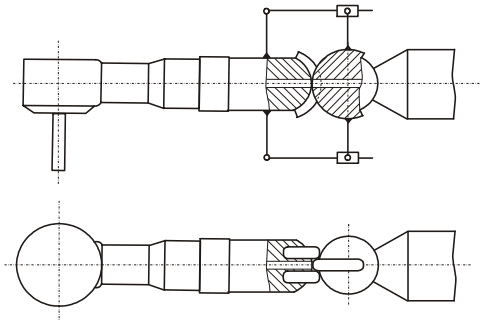

Fig. 4. The protuberantly sphere joint

The control of the head angle can be realized handily by the button– distributors for change the direction of the air pressure and simultaneously acting with it for not work cylinder is open.

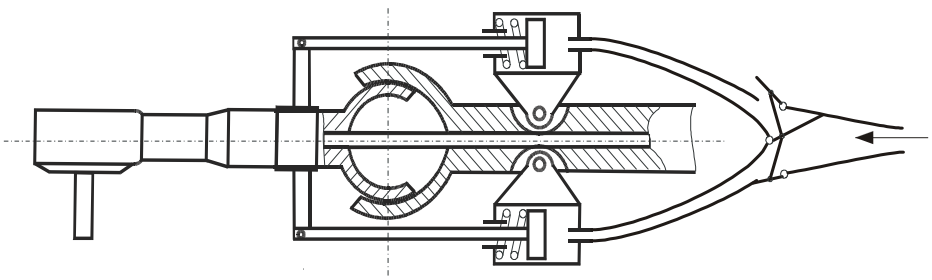

Fig. 5. The mechanism with translational joint driven by air under pressure

3. The analyses for choosing the oriented module for dental instrument

In the three examine variants is used mechanisms with closed serial kinematical chain. By reason of fact, that they are duplicated and working in the opposite can be say, that there are we have the kinematical structure with parallel action.

The combination of serial and parallel kinematics gave some advantages the more important of which are: stability of the construction, consisting of double close contour; accuracy because the reciprocally compensation the gaps in all kinematical joints; miniatures which give possibility to build in the limits sizes of the conventional dental instruments and comprise into the shape of the complex volume's working zone (Fig. 1).

In the section on Fig. 1 the zone is shown, in which the cutting head is worked, have the limits with very changeable and complex form. No doubt, adding the position mechanism will increase a little the limits sizes of the tool, but the soft positioning angle of the cutting head will allow more accurate setting the tool and wider zone of visibility. The possibility additionally local movement, only for the cutting tool head, will made easy and unburden for the dentist not to move the whole instrument.

4. Conclusion

The ideal proposal, on the base of analyze of exist construction of the dental instruments; to be built soft changing the angle of the cutting tool is made. In the addition to the above mentioned advantages, can be added the proposal improving don't make worse the sterilities and safety for the patient and the dentist. That is improving in common the existing tools making more working qualities.

The ideal proposal will be developed through kinematical and dynamic analyzes. Will be investigated and tested the possibilities to be build in it appropriated sensors which information will improve mare the dentist's labor.

R e f e r e n c e s

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Кинематические схемы вариантов для ориентированных модулей стоматологических инструментов

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Зубной врач работает в ограниченном рабочем пространстве с ограниченной видимостью. Объект этой публикации – разработка и улучшение стоматологических инструментов. В работе определены форма и границы рабочего пространства внутри человеческого рта. Сделан обзор состояния мирового опыта разработки стоматологических инструментов. Показана последовательность поиска наилучшего механизма плавного изменения угла между наконечником и держателем. Анализируется идейное решение модуля для плавного позиционирования инструмента. Сделан выбор варианта подходящего механизма. В заключении приведены преимущества идейного решения и хорошие возможности улучшения тяжелого труда зубного врача.