(57) Abstract: The invention involves an occipital plaque structuring which gives ability to move in any direction with the free action of occipital region (O) and of its connection occipital plaque (1) while the connector (6) and the rods (8) which are connected to the cervical region (S) stay stable, and which has a neck part (B) that gives an ability of action by angling of the plaque (1) with Coupling parts, and is connected to the mentioned occipital region (O) and to the cervical region (S) to where the rods (8) are connected, and with the mentioned rods (8) that implemented to connect the occipital region (O) and the cervical region (S) with each other in the injuries of these mentioned areas.
OCCIPITO CERVICAL DYNAMIC PLAQUE

Technical Field
Our invention involves the dynamic plaques which have been developed to use in the posterior dynamic stabilization operations, starting from occiput down to C1-2-3 and more in cervical spine surgeries.

The invention involves particularly occipito cervical dynamic plaques which are used by fixing to a construction of pedicle screws, rods, and/or transverse connectors in the posterior cervical system, in order to maintaining the ability of motion, not to stop losing the ability of motion by using fusion instead in the occiput region.

Background of the Art
Today, different methods and treatments have been used for the injuries of the occiput (back of the head) region. All the methods in the present technique administer the fusion of the bones in the area in order to build a static structure. In the surgical operations of the relevant region, there are many instruments in various appearances and brands for the purpose of posterior stabilization reaching to occiput-C1-2 and more the down. The most known models of this system are Ascent (Blackstone), Summit (Depuy), Oasys (Stryker), Vertex (Medtronic), Octafix (Abbott Spine) although there are many more. However, there is not a dynamic system that has been used in this area before; all these instruments are rigid systems. They constrain the neck motion of patient during the recovery period, to the extent that the patient can notice and, even can feel a pain. In other words, they seriously affect the quality of patient’s life in the future. Moreover, these systems do not have any shock absorber effects because of their rigid structures. Therefore, they speed up the degeneration in the neighboring vertebrae in time.

In this respect in the rigid systems, plaques and rods are needed to be adapted by bending and/or twisting, one by one separately, using various hand tools. This in turn brings about hardships in application and usage.

Various methods and techniques used today are listed in the section of previous technique:
Pin-and-Wire Fixation

A method of pin fixation, in which the pin is passed through the occipital external protuberance and the ends of the pin are used as fixation points for rods or wires, has also been described. Wires or rods attached to the free ends of the pin and the cervical spine secure the suboccipital bone to the cervical spine. This treatment has been successful in patients who have upper cervical instability due to cancer metastasis.

Screw-and-Plate or Screw-and-Rod Techniques

An inverted Y-shaped screw plate, which also has been described, is used to secure the occipitocervical junction. Using this technique the plate is secured to C1-2 with transarticular screws and to the suboccipital bone with paramedian screws. The suboccipital bone varies in thickness, with a mean thickness of 14 mm. Screws must be carefully selected to provide adequate purchase, yet avoid cerebellar injury. Utilizing the maximum screw length possible is critical because shorter screws do have decreased resistance to pullout. If stabilization is required below the C1-2 level, then lateral mass screws can be placed through additional holes in a longer plate to include these levels as well. A bone graft is again added to promote fusion.

Screw-and-Rod Fixation

Several lateral mass screw and rod systems that are available for subaxial cervical spine fixation have the capability to attach to the suboccipital bone. These systems are easy to contour and provide rigid fixation. Abumi and colleagues have also described an occipitocervical reconstruction in which pedicle screws and occipitocervical rod systems are used. These systems provide high fusion rates and a significant correction of malalignment.

The C1-Occipital Condyle Screw

In 2003 Gonzalez and associates evaluated a transarticular screw technique in which the occipital condyle is affixed to C-1. A 1.5mm-diameter end-threaded steel guidewire was drilled from C-1 into the occipital condyle. The entry point was at the midpoint of the posterior aspect of the lateral mass of C-1, underneath the sulcus arteriosus. The middle aspect of the occipital condyle was used as an initial target for the trajectory of the guidewire. The trajectory was monitored on anteroposterior and
lateral fluoroscopic images until the wire tip reached a point 1 cm rostral to the tip of the odontoid process. The guidewire was directed medially 10 to 20° across the occipital condyle. This was monitored on the anteroposterior fluoroscopic image. A pilot hole, 30 mm deep, was then created by using a 2.7-mm cannulated bit. The hole in the C-1 portion and the proximal portion of the condyle was widened using a 4-mm drill. A lag screw was then placed. By using a lag screw, the occipitocervical gap could be reduced. Although this was an in vitro biomechanical study, the authors do report the successful treatment of one 17-year-old patient and provide 7 months of follow-up data in that case.

Biomechanical Studies

There are multiple studies in which the various occipitocervical fixation techniques have been evaluated. Overall, most techniques do provide stability, at least in some planes of movement. Most methods proved to be susceptible to fatigue and loss of reduction over time. The methods noted to be the most stable were screw fixation techniques that included occiput-C2. These shorter segment fusions were noted not only to reduce the number of vertebral segments necessary to be included in the fusion, but also to provide superior immobilization, resistance to fatigue, and resistance to vertical settling compared with sublaminar methods. These observations were confirmed in a series in which lateral mass screws were compared with sublaminar wiring techniques as a point of cervical fixation in patients with rheumatoid arthritis. In another series there was an evaluation of sublaminar wiring-and-rod techniques; occipital screws with C-2 laminar claws and hooks and/or rod; occipital screws with foramen magnum screws and C1-2 transarticular screws and rods; occipital screws and C1-2 transarticular screws with a Y plate; and occipital screws and C-2 pedicle screws with rods. The authors' conclusion was also that occipitocervical stabilization attained using C1-2 transarticular screws or C-2 pedicle screws was biomechanically advantageous compared with stabilization that relies on sublaminar wiring or hook constructs. Pedicle screw fixation demonstrated the greatest degree of stiffness among the five constructs that were tested.
Nevertheless, all plate screw implant systems have some disadvantages in common. The position of the plate holes is fixed and not always adaptable to the actual anatomic situation. The insertion angle of the screws is restricted to a certain angle, depending on the geometry of the screws and holes. Rod screw implant systems were developed to overcome these disadvantages, and showed good clinical results.

Still today, in the patent document numbered FR2760629 and named as "Occipital-cervical surgical connector"; The implantable connector has two elongated coupling plates (2,3) each formed with a vertebral section (2A,B) extending longitudinally at each side of the spine (A-E) and fixed by pedicular screws (4) extending thorough longitudinal openings (5) in the plates. The vertebral section is extended at its upper end by an occipital section (OA.B) following the form and angle of the occiput (o). The vertebral section is flat and has rectangular openings (5) of a length (L) corresponding to a distance equal to that (P) separating at least two vertebrae and of a width superior to the shanks (e) of the screws.

The stated invention, as seen in figure 6, has a rigid structure which consists of two long plaques that connect occipital and cervical regions without giving any ability of motion. There is no application of a joint around neck area. After the implementation, the patient cannot move his head and must stay immobile during all recovery period. It is not advantageous because it has a structure that prevents the motion.

Still today, in the patent document" numbered US5545164 and named as "An occipital clamp assembly (2); An occipital clamp assembly. The occipital clamp assembly comprises a lower occipital plate for attachment to the skull of a patient, wherein the lower occipital plate includes grooves in its upper surface. An occipital plate stud mounted in the lower occipital plate and upper occipital plates, having a groove in each of their lower surfaces, mounted on the occipital plate stud wherein the grooves of the lower occipital plate mate with the grooves of the upper occipital plates to thereby form rod receiving apertures. Also provided is means for securing the upper occipital plate b the occipital plate stud and means for securing the lower occipital plate to the skull.
The stated invention has a rigid structure which connects the occipital region and cervical region. Yet this implementation does not give any freedom of mobility to the patient, because it does not have any joint around the neck area. Therefore, it is hard to use for patients.

As a conclusion, since the implementations in all present systems comprise a static state by terminating the ability of action in the application area, the present solutions are all inadequate. Thence, the presence of a need for occipito cervical dynamic plaque has forced the developments in the related technical area.

Objective of the invention
In order to dispel the disadvantages of the technique in its present state, one objective of the invention is to give an ability of action, and not to prevent the moving of patient's neck after surgery.

Another objective of the invention is to provide sharing of load by the normal cervical axis by an ability of action.

Another objective of the invention is both to increase the quality of patient's life and to delay or slow down the degeneration by providing an ability of action and sharing the load.

Another objective of the invention is that the system is easy to apply in the surgical area.

Another objective of the invention is that it protects the part which also gives ability of action; by connecting the occiput plaque to the occiput region.

Another objective of the invention is to prevent the friction of metal-to-metal by means of a lining made of polyethylene (UHMWPE) material, and placed between the plaque and the joint.

Another objective of the invention is to provide a fixation of rods and the sphere head which gives an ability of action to the system by a joint.

Another objective of the invention is to provide a protection to the plaque and the head of the joint which gains the ability of action by the capsule.

Another objective of the invention is to secure the connection of cervical and occiput constructions to each other via set screws, by locking the rods of stabilization in the cervical area to the connector.
Another objective of the invention is to connect the construction in the cervical area to the construction in the occiput area by a connector.

Another objective of the invention is to unite the capsule and the connector by a Coupling part.

Another objective of the invention is to obtain the construction in the cervical area by a rod.

Other preferred alternative structures of the invention:

1- The shape of the dynamic segment can be changed; in other words, a hinge system can be obtained, which would allow only fro-back flexion-extension, aside a top-socket system.

2- Also related with the dynamic segment, a spiral part made of nitinol, which is used markedly in the new dynamic lumbar posterior stabilization system, can be put. This system essentially is more logical than the one we propose; because it has better shock absorbency. However, its disadvantage is the risk of nitinol being deformed in time.

3- The proposed system essentially consists of rigid rods. It requires making of a second product that will be combined with spiral (flexible) ropes.

4- This second product, that is planned to be made of Titanium, can be also made of materials such as peek, carbon reinforced peek, nitinol, derlyn, high molecule polyethylene, polyethylene, or by making some parts (i.e., dynamic surfaces, assuming that minimum friction will be obtained) of these materials, alternatives can be achieved. Particularly, those made of 30% carbon reinforced PEEK can be advantageous, because they can give good results with MRI.

In the injuries of occipital region and cervical region, there are rods, which are implemented to connect the relevant regions to each other; structuring the occipital plaque containing Coupling parts; a neck part that helps to the ability of action by angling the plaque which unites the occipital area to the cervical area that is connected to the rods.

Structuring the occipital plaque involves a dynamic occipital plaque to be joined to the occipital region.

Structuring the occipital plaque involves arms to be joined to the occipital region.
For the connection of neck part, the plaque has a ring. It has a joint allowing the neck part for moving and angling. For the rotation of joint, it has a round element. In order to unite the joint with the connector which connects the rods (8) to each other, there are flat side faces on the mentioned joint. There is a lining between the ring of dynamic plaque and the joint to prevent the plausible friction. There is a capsule which connects both the lining and joint to each other, and these to the ring, and also to their cases. There is a Coupling part which connects the capsule with the joint, and with the connector that connects the rods. There is a set screw joining the rods to the connector.

The structural and characteristic features of the invention and its all advantages will be clearly understood with the drawings below, and the detailed explanations that are referred to these drawings; therefore, the evaluation must be made with these drawings and the detailed explanations in the consideration.

Explanations of the Drawings

Figure 1: The dismantled perspective of the invention.
Figure 2: The free upward motion of the invention.
Figure 3: The free downward motion of the invention.
Figure 4: The free leftward motion of the invention.
Figure 5: The free rightward motion of the invention.
Figure 6: The look of the region with the previous technique and implementation.

Reference Numbers

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<th>No</th>
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<th>Function</th>
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<td>1</td>
<td>Occiput Plaque</td>
<td>The part that is joined to occiput region. At the same time, protects the part that gives an ability of action.</td>
</tr>
<tr>
<td>1.1</td>
<td>Arms</td>
<td>The parts that are joined to the occipital region,</td>
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Detailed Explanation of the Invention

In order to eliminate the unfavorable features of the technique in its present state, the invention involves occipito cervical dynamic plaques (1) which are used by fixing to a construction that is constituted by pedicle screws, rods, and/or transverse connectors in the posterior cervical system in order to maintain the ability of action, not to stop losing it by a fusion in the occipital region (O).
In Figure 1, a dismantled perspective of the invention is shown. According to the drawing, the occiput plaque (1) is seemingly the same as of the ones in the rigid systems. In the same way, it is united to the occipital area (O) with bone screws. The difference is that the part called 'neck' (B) is in the lower part. Two sides of the neck (B) have been flattened in order to fit to the capsule. The joint (3) in the lower part of the neck is in contact with a lining (2) made of polyethylene material providing to eliminate an erosion to be caused by the plausible friction of metal-to-metal. The lining (2) has been built to fit into the occiput plaque (1) and, its inner surface (2.1) has been carved in a concave form enabling the round element (3.1) of the joint (3) to move in all directions freely.

The round element (3.1), the head part of the joint (3), has been formed in a spherical shape in order to that the occiput plaque (1) can move in all directions. The two sides (3.2) of its lower part have been flattened, enabling it to hold to the connector (6) perfectly, and at the same time, it has grooves to prevent its upward movement in case of the connector (6) forces.

The capsule (4) has been put together by locking the occiput plaque (1) to it, in a way that the joint (3), the round element (3.1) and the lining (2), all together have been encased in the capsule. In this way, a joint has been obtained in the system.

The system, that its imaginary motions are as shown in Figures 2, 3, 4 and 5, has a feature of free action ability via this joint. The ability of the joint has been limited by that the joint (3) of the capsule (4) touches to the round element (3.1). During the implementation of this constructed joint, it is adaptable to the angle between cervical (S) and occiput (O) regions, which varies for each patient according to his/her anatomic structure.

The connector (6) is united to the joint (3) by a Coupling part (7). The connector (6) secures the occiput dynamic plaque (1) via rods (8) coming from the stabilization in the cervical area. In addition, a set screw (5) is used to join the rods (8) to the connector (6). The rods (8) are fixed to the connector this way.

In the upward motion of the system in Figure 2, the occipital plaque (1), which is connected to the upward motion of the occipital area (O), also makes an upward
motion while the connector (6) and the rods (8) connected to the cervical region (S) are stable. In the same way, rightward, leftward, downward and other small actions in between are also obtained. (Figure 3, 4, 5)

Also as seen Figure 3, 4 and 5, in the injuries of occipital area (O) and cervical area (S), the structuring of occipital plaque, which is joined to the occipital area (O) and to the cervical area (S) that has rods (8) and Coupling parts connecting the mentioned areas to one another, has the ability of action in any direction via the ability of action of the occipital region (O) and of the occipital plaque that is connected to occipital region, while the rods (8) connected to the cervical region (S), and connecter (6) stay stable. The occipital area (O) is connected to the stable cervical area (S), but has ability of free action itself.

The invention is mantled on the construction after the cervical region (S) is stabilized.

As seen in Figures 2, 3, 4 and 5, our invention is connected to the rods (8). It is fixed to the occipital region (O) with a suitable angle according to the anatomic structure via bone screws. With this, the implementation is completed.

The extent of this application, being indicated in the claims section below, cannot be limited with the above explanations that have been made with sampling purposes. It is obvious that any person who is an expert in the technique can put forward the innovation of the invention using similar structures and/or can apply this structure using the related technique in the other similar areas. Therefore, it is obvious that such structures will be absent of the criteria of innovation.
CLAIMS

1. Occipital plaque structuring which have rods (8) that implemented to connect the occipital region (O) and the cervical region with each other in the injuries of these mentioned areas, it is characterized with a neck part (B) that gives an ability of action by angling of the plaque (1) and is connected to the mentioned occipital region (O) and to the cervical region (S) to where the rods (8) are connected,

2. A plaque structuring according to Claim 1, it is characterized with a dynamic occipital plaque (1) that will be fixed to the occipital region (O).

3. A plaque structuring according to Claim 1 and 2, it is characterized with the arms (1.1) that are fixed to the occipital region (O).

4. A plaque structuring according to any of previous claims, it is characterized with a ring (1.2) of the mentioned plaque (1) that is connected to the neck part (B).

5. A plaque structuring according to Claim 1, it is characterized with a joint (3) that enables the mentioned neck part (B) to move and to angle.

6. A plaque structuring according to Claim 1 and 5, it is characterized with a round element (3.1) that enables the mentioned joint (3) to rotate.

7. A plaque structuring according to Claim 1 and 5, it is characterized with the side surfaces (3.2) that are flattened on the mentioned joint (3) in order to unite the joint (3) with the connector (6) which connects the mentioned rods (8).

8. A plaque structuring according to Claim 1 and 5, it is characterized with a lining (2) that is to prevent any plausible friction between the mentioned dynamic plaque ring (1.2) and the mentioned joint (3).

9. A plaque structuring according to any of the previous claims, it is characterized with a capsule (4) that is both to encase the mentioned lining (2) and the joint (3), and also to connect them to each other and to the ring (1.2).

10. A plaque structuring according to any of the previous claims, it is characterized with a Coupling part (7) that unites the mentioned joint (3) and the capsule (4) with the connector (6) connecting the mentioned rods (8).
11. A plaque structuring according to any of the previous claims, it is characterized with a set screw (5) that fixes the mentioned rods (8) with the mentioned connector (6).

12. Usage of occipital plaque structuring which is fixated to the occipital region (O) and to the cervical region (S), and has Coupling parts and rods (8) implemented to connect the mentioned regions in the injuries of these regions, wherein moving in any direction with the free action of occipital region (O) and of its connection occipital plaque (1), while the connector (6) and the rods (8), which are connected to the cervical region (S), stay stable.

13. Usage of occipital plaque' structuring according to Claim 12, wherein the occipital region (O) is able to move freely and individually, while it is still connected to the cervical region (S).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION & SUBJECT MATTER

INV. A61B17/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 6 296 644 B1 (SAURAT JEAN [FR] ET AL) 2 October 2001 (2001-10-02) figures 5, 6, 11 column 6, lines 12-39 column 4, lines 60-62 column 6, line 66 - column 7, line 6</td>
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Special categories of cited documents:

'A' document defining the general state of the art which is not considered to be of particular relevance

'E' earlier document but published on or after the international filing date

'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'O' document referring to an oral disclosure, use, exhibition or other means

'P' document published prior to the international filing date but later than the priority date claimed

'T' later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

'X' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

'Y' document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

'Z' document member of the same patent family

Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search: 5 June 2008

Date of mailing of the international search report: 24/06/2008

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer

Louka, Maria

Form PCT/ISA/210 (second sheet) (April 2005)
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<td>GB 2 212 211 A (DANA CORP [US]) 19 July 1989 (1989-07-19) page 6, lines 7-9 figures 1, 2</td>
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**INTERNATIONAL SEARCH REPORT**

**Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.: 12, 13
   because they relate to subject matter not required to be searched by this Authority, namely:
   
   Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery

2. [ ] Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 

**Remark on Protest**

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)
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