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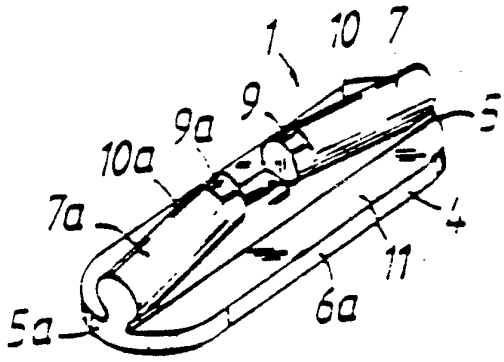
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(54) Title: AN ARTIFICIAL JOINT MECHANISM FOR USE IN RECONSTRUCTING JOINTS



(57) Abstract

An artificial joint mechanism for use in reconstructing joints such as wrists and finger joints. The joint mechanism is designed for use between fixtures anchored in the bone and/or tissue on each side of the joint. The joint mechanism comprises a male part (1) with at least one joint pin protruding from a base plate (4) and having a substantially arc-shaped joint surface, and a female part (2) with a recess (13) corresponding to the joint pin and having a substantially arc-shaped defining surface (14) for contact with said joint surface in the male part.

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+ DESIGNATIONS OF "SU"

Any designation of "SU" has effect in the Russian Federation. It is not yet known whether any such designation has effect in other States of the former Soviet Union.

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An artificial joint mechanism for use in reconstructing joints.

The present invention relates to an artificial joint mechanism for use in reconstructing joints such as wrists, finger joints, etc., designed for use between fixtures anchored in the bone and/or tissue on each side of the joint.

Previously known joint mechanisms for finger joints and wrists, for instance, generally comprise a pad of resilient material which has been secured in suitable manner between fixtures anchored in the bone and/or tissue on each side of the natural joint which has been removed - see for instance US patent application No. 406,586.

However, in practice such a resilient pad has proved to have certain limitations both as to general strength and also since it lacks certain joint functions - controllable bending, lateral movement, particularly in the case of wrists, effective "locking" when under load, e.g. when the palm of the hand is used as support, etc.

The object of the invention is to eliminate the above-mentioned difficulties and drawbacks in the type of artificial joint mechanisms described above and to achieve a joint mechanism which is simple in design but still permits stable bending positions and lateral movement, and is also vastly superior to previously known constructions from the point of view of wear.

This is solved according to the invention primarily in that it comprises a male part with at least one joint pin protruding from a base plate and having a substantially arc-shaped joint surface, like a sector of a cylinder, and a female part with a recess corresponding to the joint pin and having a substantially arc-shaped defining surface,

like a sector of a cylinder, for contact with said joint surface in the male part.

According to a preferred embodiment of the invention the joint surface of the male part comprises two part surfaces separated by a central recess, said part surfaces being aligned with each other along the centre line of the base plate and extending from said recess towards the short sides of the base plate.

Suitably each part joint surface is provided with a first joint portion located close to the recess, running substantially parallel to the base plate and then continuing into a second joint portion running with slightly downward inclination towards the short sides of the base plate.

The first part joint surfaces in the male part thus cooperate with the recess in the female part, acting as a joint at bending movements, while the desired lateral movement is achieved by cooperation of the second, inclined joint portions in the male part with the recess in the female part.

According to another embodiment of the invention the second joint portions of the part joint surfaces may, depending on anatomical criteria, have different angles of inclination (α and β) in relation to the base plate.

The angles of inclination between the base plate and the second joint portions may suitably lie between 0 and 50°. The joint portions are arc-shaped and suitably define a sector angle of between 10 and 350°.

According to yet another embodiment of the invention the second joint portions of the male part may have a different, optional profile, and be arranged to cooperate with differently profiled recesses in the female part.

According to the invention the male part and the female part are secured against displacement along their cooperating surfaces. This is suitably achieved by means of bosses protruding from the joint surfaces or contact surfaces of the male and/or female parts and arranged to cooperate with corresponding recesses in respective parts or by the lateral ends of either the male or the female part being arranged to grip the short ends of the male or female part.

According to another embodiment of the invention the actual bending movement may suitably be limited by one edge portion of the female part being arranged to be brought into contact with one of the side surfaces of the base plate of the male part.

The joint mechanism according to the invention suitably consists of a biocompatible material and according to a preferred embodiment the male part consists of titanium and the female part of a suitable plastic material.

The invention will be described in more detail in the following with reference to an embodiment illustrated in the accompanying drawings in which

Figure 1 shows in a first preferred embodiment the construction of a hand with a normal wrist with the joint mechanism according to the invention applied,

Figures 2 and 3 are views in perspective showing the lower and upper side of the male part of the joint mechanism of the first preferred embodiment,

Figure 4 is an end view of the female part included in the proposed joint mechanism of the first preferred embodiment,

Figure 5 shows the female part seen from below of the first preferred embodiment, and

Figure 6 showns the male part of the first preferred embodiment illustrated in Figure 3, seen from above,

Figure 7 shows a second preferred embodiment of the invention in a representation corresponding to that in Figure 1,

Figure 8 shows the second preferred embodiment of the invention in a representation corresponding to that in Figure 3,

Figure 9 shows the second preferred embodiment of the invention in a representation corresponding to that in Figure 5.

The joint mechanism proposed according to the invention and illustrated in a first preferred embodiment in the drawings (Fig. 1 to Fig. 6) comprises in principle a male part 1 and a female part 2 cooperating therewith. The male part 1 also shows in principle a protruding joint surface designed to cooperate with a corrresponding recess in the female part 2. The two parts 1, 2 are detachably secured on the sides not cooperating with each other, to fixtures 3, 3a, not shown in detail, which have been implanted in the bone and/or tissue with the aid of bone and/or tissue anchoring devices after surgical removal of the natural joint.

In the first preferred embodiment shown on the drawings the male part 1 comprises a substantially rectangular base plate 4 with opposite short sides 5, 5a and opposite long sides 6, 6a. The joint surface of the male part 1 consists of two part joint surfaces 7, 7a aligned with each other and extending along the centre line of the base plate 4

from a central recess 8 towards the short sides 5, 5a of the base plate 4.

Each part joint surface 7, 7a has a first joint portion 9, 9a located close to the central recess 8, running substantially parallel to the base plate 4 and continuing into a second joint part 10, 10a, respectively, which runs with slightly downward inclination towards the short sides 5, 5a of the base plate.

The angles of inclination α and β may vary depending on the anatomical criteria.

The angles of inclination α and β shall be between 0 and 50°, preferably about 10°.

All the joint surface portions 9, 9a; 10, 10a are arc-shaped,like a sector of a cylinder, each joint surface suitably defining a sector angle of between about 10 to 350°, preferably 40 to 320°.

The side edges of the base plate 4 located outside the joint body are designated 11.

As shown in more detail in Figures 4 and 5, the female part 2 also consists of substantially rectangular base plate 12 with a longitudinal central recess 13 having arc-shaped defining surface 14. A protruding shoulder 15 is provided centrally in the recess 13 and is intended to cooperate with the central recess 8 in the male part 1. Two contact surfaces 16, 16a are thus also formed on each side of the shoulder 15, intended to cooperate with the arc-shaped joint surfaces 7, 7a of the male part. The female part 2 is also provided with substantially flat defining surfaces 17, 17a - one on each side of the recess 13.

When fitted the joint mechanism shown offers the following

important functions:

achievement of a stable normal bending function of the joint, where the contact surfaces 16, 16a partially - i.e. with the portions located close to the guide shoulder 15 - cooperate with the first joint portions 9, 9a of the male part,

achievement of a limitation of the bending movement, controllable in advance, in that the defining surfaces 17, 17a are brought into contact with the side surfaces 11 of the base plate 4 in the male part 1,

achievement of bending to a secured position, since the guide shoulder 15 of the female part engages in the central recess 8 of the male part 1, thus preventing lateral displacement of either part,

achievement of lateral bending movement since the contact surfaces 16, 16a are brought into contact with the inclined second joint portion 10, 10a of the male part 1, and

achievement of a stable support joint if, for instance, strong pressure is exerted on the mechanism by the palm of the hand when the body is raised from a sitting position, for instance.

The male and female parts are manufactured from material compatible with tissue. According to a preferred embodiment one part, suitably the male part, is made of metal, suitably titanium, and the female part of a plastic material, suitably polyethylene. Different materials are preferably used in the two parts in order to reduce wear.

Variations in the joint mechanism described are of course

possible within the scope of the following claims. If for some reason no lateral bending movement is necessary, the second joint parts 10, 10a need not be inclined but are aligned with the first joint parts 9, 9a.

Furthermore, the risk of lateral displacement of the two parts 1, 2 can be avoided by designing the short sides of the female part to grip the short sides of the male part, for instance, or the short sides of the joint member, in which case the shoulder 15 and recess 8 can be omitted. Furthermore, more than one shown locking arrangement may be provided between shoulder and recess. As to the design of the concentric joint surfaces of the male and female parts which cooperate with each other, instead of being arc-shaped, suitably circle-arc shaped, these could also have different surface profiles of suitable design. The first and second joint surfaces may also have different profiles from the first joint surfaces.

The joint mechanism according to a second preferred embodiment of the invention is shown in Figures 7 to 9. It comprises a male part 1′ and a female part 2′ cooperating substantially in the same way as, in the first preferred embodiment, the male part 1 is cooperating with the female part 2, except that the second joint parts 10′, 10a′ of the two-part joint surfaces 7′, 7′a but not their first joint portions 9′ and 9′ located close to the central recess 8′ are substantially banana-shaped. The second joint parts 10′ and 10a′ are running parallel to the long side 6a and inclined slightly towards the short sides 5 and 5a of the unchanged base plate 4.

The female part 2′ of the second preferred embodiment is designed to fit the male part 1′ by i being provided with recesses having substantially negatively banana-shaped surfaces 16 and 16′a, the recesses being arranged on either side of a protruding shoulder 15.

The two part joint surfaces 7', 7'a of the male part of the second preferred embodiment are aligned with each other, and are running with slightly downward inclination towards the short sides 5 and 5a of the base plate. Their angles of inclination α' and β', not indicated in the Figures but essentially similar to angles α and β of the first preferred embodiment and variable within the same limits, i.e. between 0 and 50°, preferably being about 10°, may vary depending on anatomical criteria.

All the joint surface portions 9, 9a,; 10' 10'a of the male part of the second preferred embodiment are arc-shaped, each joint surface defining a sector angle of between 10 to 350°, preferably 40 to 320°.

While the second preferred embodiment is equally efficient in its "locking" action, it surpasses the first preferred embodiment especially with regard to ease of lateral movement.

Claims

1. An artificial joint mechanism for use in reconstructing joints such as wrists, finger joints etc., designed for use between fixtures anchored in the bone and/or tissue on each side of the joint, comprising a male part (1) with at least one joint pin protruding from a base plate (4) and having a substantially arc-shaped joint surface, and a female part (2) with a recess (13) corresponding to the joint pin and having a substantially arc-shaped defining surface (14) for contact with said joint surface in the male part (1).

2. A joint mechanism as claimed in claim 1, wherein the joint surface of the male part (1) comprises two part surfaces (7, 7a) separated by a central recess (8), said part surfaces being aligned with each other along the centre line of the base plate (4) and extending from said recess (8) towards the short sides (5, 5a) of the base plate (4).

3. A joint mechanism as claimed in claims 1 - 2, wherein each part joint surface (7, 7a) is provided with a first joint portion (9, 9a) located close to the recess (8), running substantially parallel to the base plate (4) and then continuing into a second joint portion (10, 10a) running with slightly downward inclination towards the short sides (5, 5a) of the base plate (4).

4. A joint mechanism as claimed in claims 1 - 3, wherein the second joint portions (10, 10a) of the part joint surfaces (7, 7a) have different angles of inclination (α and β) in relation to the base plate.

5. A joint mechanism as claimed in claim 4, wherein the angles of inclination α and β, respectively, lie between 0 and 50°.

6. A joint mechanism as claimed in claims 1 - 5, w h e r e i n the joint portions (9, 9a and 10, 10a, respectively) are arc-shaped, like a sector of a cylinder, suitably in the shape of a circle arc, and cover a sector angle (V) of between 10 and 350°.

7. A joint mechanism as claimed in claims 1 - 5, w h e r e i n the second joint portions (10, 10a) have a different, optional profile, and are arranged to cooperate with recesses in the female part (2) having the same profile.

8. A joint mechanism as claimed in claim 7, w h e r e i n the profile of the second joint portions (10', 10'a) is substantially banana-shaped.

9. A joint mechanism as claimed in claims 1 - 6, w h e r e i n the male part (1) and the female part (2) are secured against displacement along their coopearting surfaces.

10. A joint mechanism as claimed in claims 1 - 8, w e r e i n displacement is prevented by means of bosses (15) protruding from the joint surfaces or contact surfaces of the male and/or female parts (1, 2), said bosses being arranged to cooperate with corresponding recesses (8) in respective parts (1, 2).

11. A joint mechanism as claimed in claims 1 - 8, w h e r e i n displacement is prevented by the lateral ends of either the male or the female part (1, 2) being arranged to grip the short ends (4, 5) of the male or female part (1, 2).

12. A joint mechanism as claimed in claims 1 - 11, w h e r e i n the female part (2) has edge portions (17, 17a) arranged, in order to limit bending, to be brought

into contact with one of the side surfaces (11) of the base plate (4) of the male part (1).

13. A joint mechanism as claimed in claims 1 - 12, w h e r e i n the joint surface of the male part (1) is provided with a substantially central recess (8) to receive a guide shoulder (15) protruding from the limiting surface (14) of the female part (2).

14. A joint mechanism as claimed in claim 1, w h e r e i n all the parts consist of biocompatible material.

15. A joint mechanism as claimed in claim 14, w h e r e i n the male part (1) consists of a metallic material, preferably titanium, and the female part (2) consists of a plastic material, preferably polyethylene.

AMENDED CLAIMS

[received by the International Bureau on 5 February 1992 (05.02.92) ; original claims 1-15 replaced by amended claims 1-15 (3 pages)]

1. An artifical joint mechanism for use in reconstructing joints such as wrists, finger joints etc., designed for use between fixtures anchored in the bone and/or tissue on each side of the joint, comprising mutually engageable male (1) and female (2) parts, said male part (1) comprising two joint pins having substantially arc-shaped joint surfaces like sectors of a cylinder (7, 7a) and a central recess (8) between them, said pins being aligned with each other and extending from the recess (8), and said female part (2) comprising a central recess (13) with an arc-shaped defining surface (14) extending in longitudinal direction, said recess (13) being provided centrally with a shoulder (15) arranged for cooperation with the central recess (8) of the male part (1), and having two contact surfaces (16, 16a) for cooperation with the arc-shaped joint surfaces (7, 7a) of the male part (1), c h a r a c t e r i z e d in that said male part (1) comprises a base plate (4) and said female part (2) comprises another base plate (12); to which base plate (4) of the male part (1) said joint pin is protrudingly joined and in which base plate (12) of the female part (2) said recess (13) is arranged.

2. A joint mechanism as claimed in claim 1, w h e r e i n the joint surfaces (7, 7a) of the male part (1) have first joint portions (9, 9a) located close to and extending from the recess (8), said first joint portions (9, 9a) having their axes arranged substantially parallel to the surface of the base plate, and second joint portions (10, 10a) joined to the first joint portions (9, 9a), said second joint portions (10, 10a) having their axes arranged with slightly downward inclination towards the base plate (4).

3. A joint mechanism as claimed in claim 2, w h e r e i n said second joint portions (10, 10a) of the male part joint surfaces (7, 7a) have different angles of inclination (α and β) in relation to the base plate (4).

4. A joint mechanism as claimed in claim 3, w h e r e i n said angles of inclination (α, β) lie between 0 and 50°.

5. A joint mechanism as claimed in claim 3, w h e r e i n said angles of inclination (α, β) are about 10°.

6. A joint mechanism as claimed in claims 2 - 5, w h e r e i n the sector angle covered by said arc-shaped joint portions (9, 9a; 10, 10a) of the joint surfaces (7, 7a) of the male part (1) covers a sector angle of between 10 and 350°, preferably between 40 to 320°.

7. A joint mechanism as claimed in claims 2 - 6, w h e r e i n said second joint portions (10, 10a) of the joint surfaces (7, 7a) of the male part (1) have different, optional profiles, and are arranged to cooperate with said contact surfaces (16, 16a) of the recess (13) of the female part (2), which contact surfaces (16, 16a) have profiles corresponding to the profiles of said second joint portions (10, 10a).

8. A joint mechanism as claimed in claim 7, w h e r e i n the profiles of said second joint portions (10', 10a') are substantionally banana-shaped.

9. A joint mechanism as claimed in claims 1 - 6, w h e r e i n the male part (1) and the female part (2) are secured against displacement along their cooperating surfaces.

10. A joint mechanism as claimed in claim 9, w h e r e i n said shoulder (15) is arranged to prevent said lateral displacement.

11. A joint mechanism as claimed in claim 9, w h e r e i n said lateral displacement is prevented by the lateral ends of either the male part (1) or the female part (2) being arranged to grip the short ends (5, 5a) of the male part (1) or the short ends of the female part (2), respectively.

12. A joint mechanism as claimed in claims 1 - 11, w h e r e i n the female part (2) has edge portions (17, 17a) arranged, in order to limit bending, to be brought into contact with a surface (11) of the male part (1) adjacent to said joint pins.

13. A joint mechanism as claimed in claim 12, w h e r e i n said edge portions (17, 17a) are substantially flat defining surfaces arranged on each side of said recess (13).

14. A joint mechanism as claimed in claim 1, w h e r e i n all parts consist of biocompatible material.

15. A joint mechanism as claimed in claim 14, w h e r e i n the male part (1) consists of a metallic material, preferably titanium, and the female part (2) consists of a plastic material, preferably polyethylene.

Fig. 1

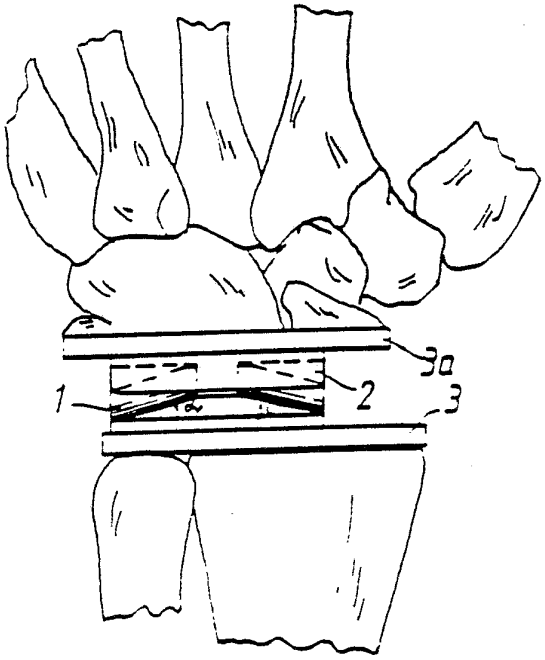


Fig. 3

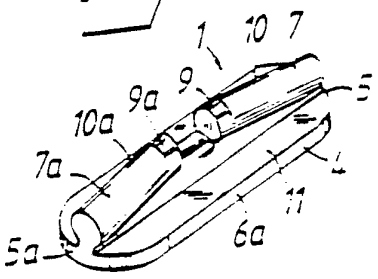


Fig. 2

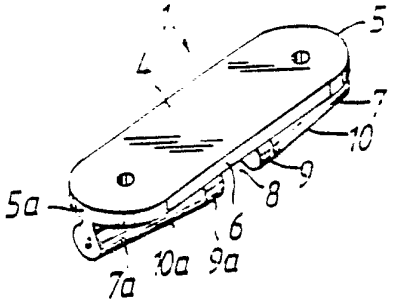


Fig. 4

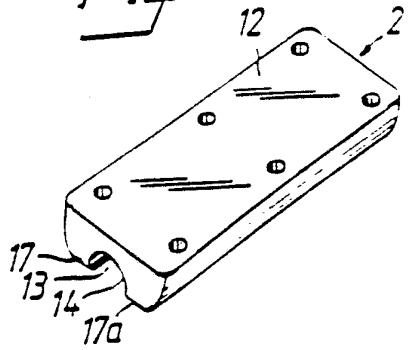


Fig. 5

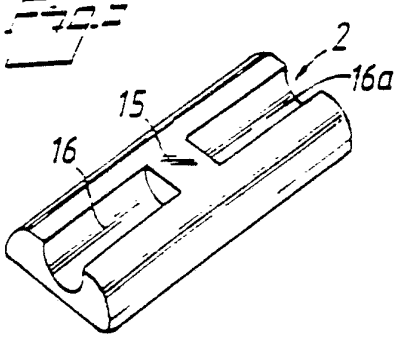


Fig. 6

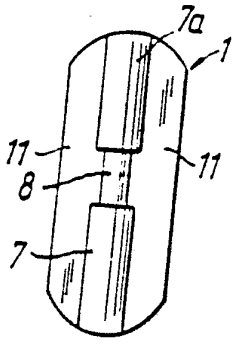


Fig. 7

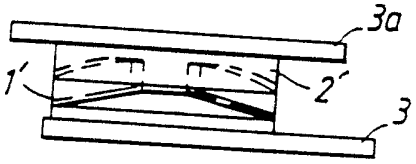


Fig. 8

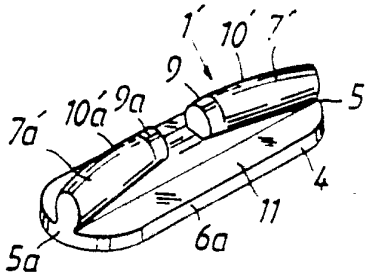
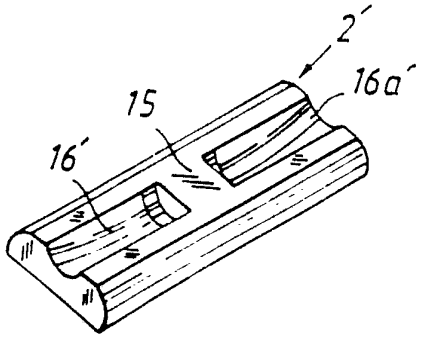


Fig. 9



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 91/00586

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: A 61 F 2/30, 2/42

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	A 61 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US, A, 3991425 (MARTIN ET AL) 16 November 1976, see column 3, line 43 - line 64; figure 2 --	1-3,6-7, 9-10,13-15
X	US, A, 4383337 (VOLZ ET AL) 17 May 1983, see figure 7; claims 1-7 --	1-3,6-10,13-15
X	US, A, 4784661 (BECKENBAUGH ET AL) 15 November 1988, see figure 3; claim 1 --	1,5,8, 14-15
A	US, A, 4944758 (BEKKI ET AL) 31 July 1990, see the whole document --	1

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* Special categories of cited documents:[10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
29th November 1991	1991 -12- 03
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	LEIF BRANDER

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 91/00586

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the Swedish Patent Office EDP file on 31/10/91 The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		GB-A- 1554956	79-10-31
US-A- 4383337	83-05-17	NONE	
US-A- 4784661	88-11-15	NONE	
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