# Archwires Designed For Individual Patients

GEORGE N. BOONE, D.D.S., M.S.
*Pasadena, California*

Archwires are the vital and motivating parts of an orthodontic appliance. They store and deliver power through the brackets and bands to the teeth and surrounding tissues. A good archwire forming technique is an essential part of good orthodontic treatment. Exacting standards and procedures for diagnosis, treatment planning, and mechanical therapy have been developed and are in use; yet, methods for forming archwires have often been time-consuming and inadequate.

The purpose of this paper is to present a technique that will produce accurately-formed archwires in an efficient and practical manner. This technique establishes individualized arch form, correct cuspid and molar lateral widths, bilaterally equidistant positions on the peripheral arch, general symmetry and well-coordinated maxillary and mandibular archwires.

The wires should be designed and constructed to conform to the various requirements that have been evaluated and decided upon in the diagnosis and treatment plan for the patient. Some of the points that should be considered for this planning are: arch form, length, expansion, contraction, symmetry and first, second and third order bend positions.

Improperly formed archwires create and contribute to many posttreatment problems. Unplanned contraction or expansion, especially in the cuspid or molar regions, produces instability. Correct cuspid and molar lateral widths should be determined and decided upon as an integral part of the diagnostic procedure and, once these widths have been established, they should be maintained throughout treatment. This will prevent unnecessary movement of the teeth which is undesirable and could cause tissue damage.

Peripheral arch length positions must be bilaterally equalized if the case is to be treated successfully. Peripheral arch length positions may be defined as those distances from the anterior midline of the archwire along it distally to determined positions; an example would be the first molar offsets. Proper articulation of the teeth is difficult to achieve if, for example, the molars in the left buccal segment are farther from the anterior midline distally than those in the right buccal segment. To obtain good occlusion it is necessary to equalize the archwire bend positions in this mesiodistal dimension.

Maintaining symmetry is very important in forming archwires. Asymmetrical wires leave the anterior or buccal segments out of harmony and make midline deflections difficult to correct.

Equally important is the coordination or creation of the proper relationship of the maxillary and mandibular wires to each other. Coordination between them must be accomplished if a good intercusp relationship between the opposing arches is to be achieved.

The individuality of the patient's arch form must be recognized and respected if a successful and permanent orthodontic result is to be achieved. Careful attention should be given to discriminating between the various types of arch forms such as ovoid, tapering, or square and gradations between them. Stability of the case depends on incorporating the correct arch form in-

to the archwire.

Various archwire-forming techniques are based upon construction of the maxillary wire to which the mandibular wire is conformed. Many authorities, however, establish the diagnosis and treatment plan for the patient from the mandibular denture. They suggest conforming the maxillary teeth to this ideally positioned mandibular arch. In the technique we are proposing the mandibular archwire is constructed first in accordance with the dictates of the diagnosis and treatment plan. The maxillary archwire is then formed and coordinated to the mandibular.

To meet the preceding requirements for the creation of proper archwires an "Arch Formation Card" was devised. When properly filled out, it serves as an individualized prescription from which archwires can be constructed. The arch-formation card records the data taken from the patient concerning arch form, arch length, width and the bends and accessory positions. On this card an arch can be so described as to make it possible to form the archwire at a later time either by the orthodontist or by a qualified technician. Another important benefit from such a procedure occurs when more than one orthodontist is working for the same patient. A treatment plan can be decided upon and arch designs determined by the operators at the beginning of treatment. These measurements and plans can be recorded on this card so that the efforts of both of them can be unified toward a definite goal.

As illustrated in Figure 1, the arch-formation card is divided into three portions. The top portion is called the identification area. The middle portion, called the information area, contains data regarding the type of arch, size of wire, and the kinds and positions for placement of the various bends and accessories for future reference. In the lower portion or working area, the measurements are recorded and the archwire constructed.

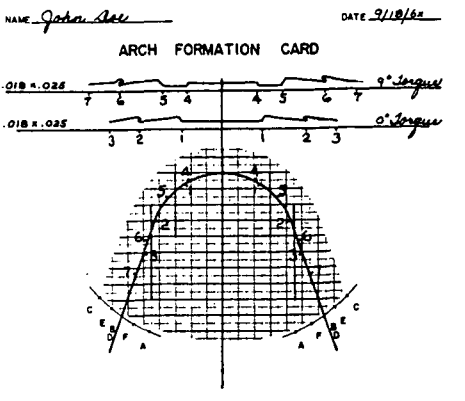


Fig. 1

The working area, as shown in the illustration, has vertical lines spaced at equal distances from the midline, making it possible to balance the arch laterally from this midline. The horizontal lines form a grid with the vertical lines. Using these lines, it is possible to position the various bends, loops and arch ends at equal distances, distally, from the midline along the archwire. Superimposed on the grid is a heavy "arch guideline". It is used to establish and maintain general symmetry in the curved or arched dimension. Peripheral arch-length measurements are recorded along this line, and on it the archwire blank is made. This line will be used as a guide to symmetry and along it will be recorded the positions of the first, second and third order bends in forming the archwires. The arch blank will be changed when the wire is being individualized for arch form and lateral widths in the final stages of its construction.

The measurements that are made to modify the wire from the arch guideline design and, therefore, to meet the needs of each individual case are called lateral width lines. These lines are re-

corded on the working area of the chart as parallel lines laterally and equidistant from the midsagittal line and represent the lateral dimensions of the archwire. During construction the wire will be so adjusted that the various bracket engagement areas will fall along these lateral width lines. Lateral width measurements are made in the mouth after the teeth are banded. The measurements are made at the tube or bracket openings. This information will be modified for expansion or contraction if the treatment plan calls for such a procedure. In extraction cases the molars generally move forward and the cuspids generally move posteriorly into the extraction space. These movements decrease the lateral width in the molar areas and increase it for the cuspid areas. Adjustments for these movements are also made and these data are recorded on the chart by lateral width lines. The first molars and cuspids are generally plotted, but other teeth in the mandibular segment can be located if it is desired.

Measurements are next made to determine the positions for the first order bends, closing, opening, leveling and alignment of loops, hooks, fingers and other accessories on the archwire. This is done by utilizing the simple, yet accurate, cord principle often used in other fields. The principle involves measuring the cord of an arc to obtain its circumferential linear dimension (Fig. 2).

In measuring for the desired bend positions, it is helpful to have either the previous archwire or a brass wire in the brackets so that the positions on the arc can be determined accurately for the cord measurements. The dimensions are then taken from the midline to wherever lateral insets, cuspid and molar offsets, loops, spurs, tie-backs, or other accessories will be needed. Measurements are made from the midline distally on both the right and left sides and, whenever possible, are adjusted so that they will be equidistant from this midline (Fig. 3). This information is recorded along the guideline of the working area (Fig. 4) and is also noted in the information area (Fig. 5) where a diagram of the specific types of bends will be made to identify the type of bend desired.

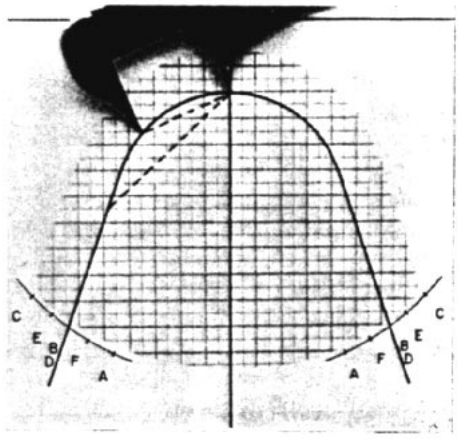


Fig. 2

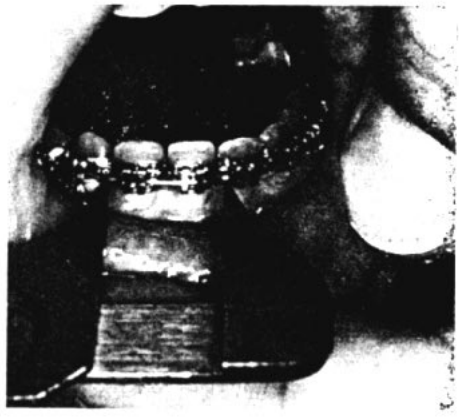

Fig. 3

Measurements are taken from the patient with a Boley gauge that has been modified to be easily used in the mouth.

The technique of constructing a set of maxillary and mandibular rectangu-

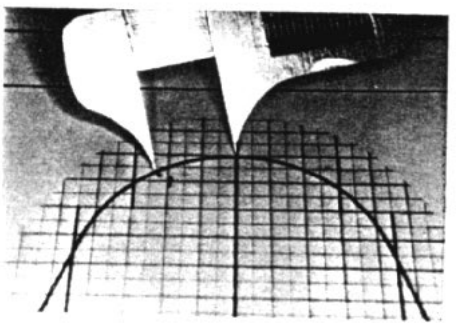

Fig. 4

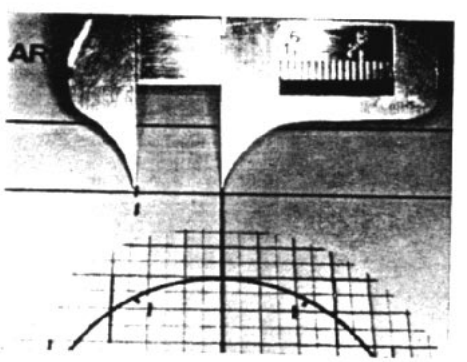

Fig. 5

lar archwires will be described. To simplify this example the second permanent molars will not be banded and no loops or other accessories will be added to these simple archwires.

Mandibular molar lateral widths are measured with the modified Boley gauge directly in the mouth at the molar tube openings. To this measurement will be added the amount of expansion or contraction that was decided upon in the treatment plan. When these adjustments are made the measurement is placed on the working area of the arch-formation chart, the molar lateral width lines are drawn parallel and equidistant from the midline of the chart. (Fig. 1) The same technique is used in determining the mandibular cuspid widths. These widths are recorded on the chart as lateral cuspid width lines. We have found that these two sets of measurements are usually sufficient for our purpose but, if it is desired, similar ones can be made for the bicuspids and second molars. At this point the working area of the card has molar and cuspid lateral width lines which represent the lateral dimensions of the archwire where it will pass through the tubes or brackets of these banded teeth.

Measurements are next made to determine positions for the first order bends. These will be made from the midline of the brass wire or previous archwire in the mouth, along it distally on both the right and left sides, using the cord principle. Whenever possible these measurements will be adjusted or modified so that they are equal. These measurements are made as follows.

In this example we will place cuspid offsets in the mandibular archwire. The distance for these offsets is obtained from the midline to the desired position between the lateral incisor and cuspid on both the right and left sides (Fig. 3). This measurement is transferred and marked on the guideline of the arch-formation card, on both the right and left sides and given an identification number which, in this case is "1" (Fig. 4). These same measurements are then transferred to the identification area and placed on the lower of the two parallel lines and given the same number (Fig. 5).

We place the mandibular wire numbers on the inside of the guideline of the working area and on the lower of the two parallel lines in the information area. The maxillary numbers will be placed on the outside of the guideline and on the upper of the two parallel lines in the information area.

To locate the first molar offset, measure from the midline to the right and left molar offset areas using the cord principle. This information is marked on the arch guideline and in the information area, and is given the number "2" for identification.

Distances from the midline to the ends of the arch are also measured and noted on the arch guide line and in the identification area. They are given the identification number "3".

A diagrammatic sketch of the arch is made in the information area indicating what types of bends are to be made and locating their positions. With this diagram and the identification numbers that are used, it is easy to identify each mark on the arch guideline as to the specific type of bend needed.

The next step is to obtain data for the maxillary archwire. As in the mandibular procedure it is helpful to have a brass wire or a previous archwire in the brackets to measure more accurately. We measure from the midline to the lateral inset areas and, if possible, equalize these measurements on both the right and left sides. They are noted on the arch guideline (on the outside) and also on the information area. In this case they are designated number "4".

Still following the procedure as used for the mandibular arch, we measure from the midline to the right and left areas for the cuspid offsets and, after equalizing these measurements, transfer them to the guideline and to the upper line of the information area. These marks are assigned the number "5". Measurements are made for molar offsets and noted on the chart in the same manner and designated number "6". The desired lengths of the archwires are also measured and transferred to the working and identification areas and designated number "7."

With these measurements completed, the marks on the working area tell accurately where the bends are to be located on the archwire. The diagram in the information area identifies and tells what to do with each mark that has been recorded in the working area. For example, number "2", that is diagrammatically illustrated in the identification area as a molar offset and recorded on the arch guideline in the working area, identifies the first molar offset positions. This is true of all the positions that are marked on the archwires.

We now have a prescription for an individualized set of wires on the arch formation card. All the descriptive data that is necessary for this particular patient have been recorded. Correct cuspid and molar lateral widths and exact positions for first order bends in both the maxillary and mandibular archwires have been accurately established. The wires have been oriented laterally by the cuspid and molar lines, mesiodistally by the peripheral arch measurements on the guide, and in the curved dimension by the arch guideline. With this information we will be able to fabricate an individualized, coordinated set of archwires that meets the dictates of the treatment plan for this particular patient.

The next steps describe the technique for constructing these archwires. First, an arch blank is formed by bending straight wire stock to conform to the guideline on the arch formation card (Fig. 6). A special turret is used to make this blank placing the correct

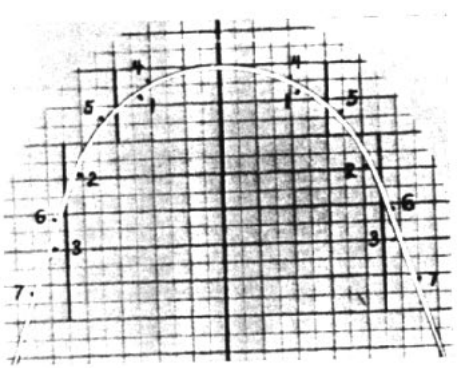


Fig. 6

torque in the anterior region. The amount of torque is determined from the original diagnosis and the treatment plan, the most recent head plate and from clinical observation. The blank is made in this form to help to maintain symmetry through the various fabrication steps. Later in the procedure, as various loops and bends are made in the archwire, the arch blank is placed back on the guide line and symmetry reestablished.

With this blank we will now proceed to form the mandibular wire. The blank is placed on the guideline and marked at the midline with a file or pencil. Next the positions for the cuspid offsets are marked. With proper pliers and finger positions, the offset bends are made, both on the right and left sides (Fig. 7). There is a definite advantage in making both the right and left first order bends or loops at the same time, because there appears to be a muscular memory in the fingers which allows one to duplicate these bends closely when they are done in pairs. It is also wise to work from the midline distally in forming the archwire so that any errors that might occur will be worked out or eliminated at the distal ends of the wire.

After the cuspid offsets are placed in the archwire, it is readapted to the guideline where the bends can be observed and symmetry checked (Fig. 7). If they are satisfactory, another set of marks is made for the positions of the first molar offsets that are represented on the chart as positions "2". With the proper pliers and finger positions, the offsets are made. Again, the partially formed archwire is placed back on the guideline to check for accuracy in bends and for symmetry (Fig. 7).

The arch ends, as located by point "3" on the guideline, are marked, cut and smoothed. The result is a mandibular archwire with the first order bends

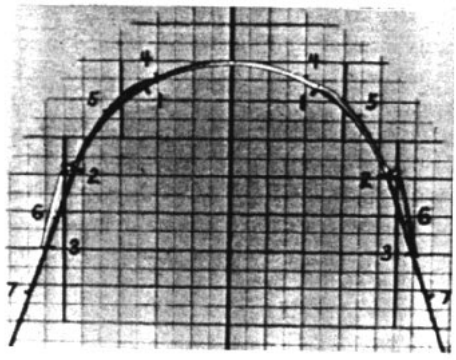

Fig. 7

accurately established (Fig. 7).

The wire is now individualized to meet the demands of the treatment for this particular patient by giving proper cuspid and molar lateral widths and correcting the anterior arch form. To accomplish this the anterior curve is altered to correspond to the desired arch form. This form should be influenced by the arch form as found in the patient and modified by the treatment plan. The archwire is also adjusted so that the cuspid bracket engagement area falls along the predetermined cuspid lateral width line. It is further modified so that the molar tube engagement area falls along the molar lateral width line (Fig. 8).

The archwire should now have the correct anterior torque, arch form, lateral widths and peripheral arch

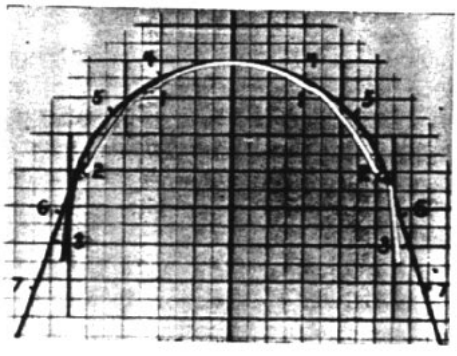

Fig. 8

lengths, as well as symmetry. The posterior torque can now be placed and adjustments made for the curve of spee.

The procedure for forming the maxillary wire is similar to that used in the mandibular. A blank is made using the turret for the correct anterior torque to accurately fit the arch guideline. The midline of the wire blank is marked to correspond with the midline of the guideline. Marks are then made on the blank for lateral inset bends and these bends are made. Again, it is advisable to make the right and left bends at the same time in order to facilitate balancing them. The blank is then replaced on the card and checked for accuracy and symmetry.

Cuspid offsets are marked and formed into the arch blank. Molar offsets are also marked and made, the ends of the wire are marked and cut to the proper length. Adjustments for the torque in the posterior area and the curve of spee are incorporated.

This archwire must now be coordinated with the previously individualized mandibular archwire that has been designed for this particular patient. This is accomplished by recontouring or reforming the maxillary wire to nestle over the mandibular in the proper relationship to it. We believe that the archwires should be coordinated in the following manner: the upper central incisor area should be approximately one arch width away from the lower incisor area; the maxillary lateral insets should closely approximate the mandibular cuspid offsets; the maxillary bicuspid and molar areas should be one to two arch widths outside of and parallel to the mandibular bicuspid and molar areas. This set of archwires is now formed in such a way that both are individualized to conform to the requirements of a particular patient (Fig. 9).

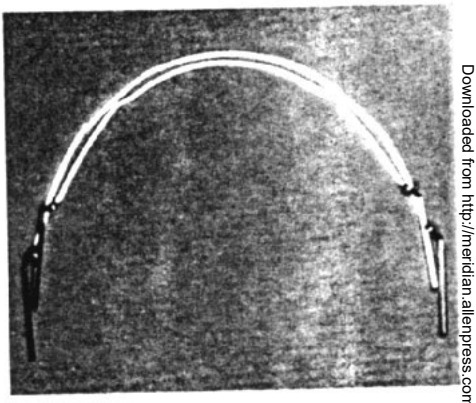

Fig. 9

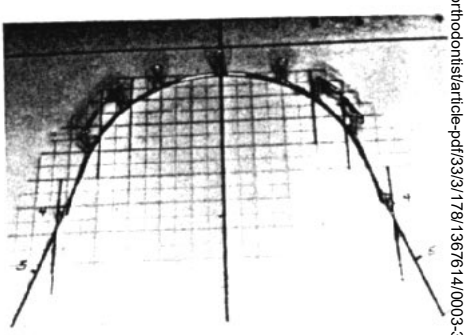

Fig. 10

An important step is the final adjustment at the chair with the patient present. All archwires are then stress relieved and polished before they are placed in the mouth.

A technique for designing and for describing orthodontic archwires to treat individual patients has been presented. Some of the following advantages are claimed:

1. It is clinically practical, accurate and correlated to the diagnosis and to the treatment plan, thereby meeting the needs of the individual patient.
2. It maintains symmetry in the lateral halves, mesiodistally and laterally, and coordinates the mandibular and maxillary archwires to each other.

3. The importance of a correct lateral width and its maintenance is recognized.
4. It permits easy and correct placement of accessories and auxiliaries, and is especially useful for making complex, multilooped archwires (Fig. 10).
5. Auxiliary help may be used in making archwires.
6. It coordinates the efforts of several orthodontists working for the same patient to a common end; it economizes time, and effort and consistently produces good results.

*3925 East Huntington Drive*