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ORTHODONTIC OFFICE DESIGN The 30-Second Difference

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Any orthodontist should easily be able to save 30 seconds per patient of doctor time simply by upgrading and rearranging the equipment in the operatory. This may allow scheduling at least two more patients per day, or 10 more patients per week, which can translate into a $25,000 gain in gross income per year.

Larger practices may see more patients, but still be restricted by their facilities. For practices with gross incomes of more than $500,000, the potential annual losses are proportionately higher.

If there ever is a time when you should consider upgrading equipment and redesigning the operatory for greater efficiency, it would certainly be during remodeling or planning a new office. Even if you are presently satisfied with the majority of your office routines, however, the concept of the "30-second-difference" might motivate you to reevaluate your present operatory floor plan and chairside work patterns–the heart of production and profit.

Time-and-motion studies are scarce in the orthodontic literature, and are usually associated with specific intraoral techniques and scheduling for various procedures.1 The most reliable time-and-motion studies have been done in general dentistry. The classic recommendations of Anderson and Hoffman in the 1950s continue to influence chairside routines even today.2 These authors, the first to routinely have the operator seated while working, revolutionized dental equipment and delivery systems. They determined the ideal tray setup, and they placed the operator in the rear-delivery position for both solo and four-handed procedures, working at the 9-11 o'clock position. New high-velocity suction systems were also placed behind the patient's head, along with handpieces.

Proponents of rear delivery in orthodontics have always pointed out its advantages in both solo and four-handed work and its potential for providing working surfaces to augment the single- tray setup3,4 (Fig. 1). The more items that can be placed within or near the primary work area, the greater the likelihood of efficient movements by the doctor and assistants.

Hoffman advanced the premise that when working chairside, the least amount of bodily movement is the most efficient in performing a task. He classified operator movements from Class I to Class V, with the higher-numbered movements being the less efficient (Table 1).

We classify any orthodontic procedure that interrupts chairside work and requires the operator to leave the chair and retrieve support items as a Class VI movement. Chasing after instruments is perhaps the greatest single violation of the "30-second difference" principle. Although some Class VI movements are inevitable in performing multiple tasks in an open-bay setting, the design of the operatory can make them less wasteful by reducing the distance to secondary storage. The frequency of interruptions can be limited by proper planning, with a chairside system that allows for unplanned multiple procedures (Fig. 2).

Dental Chair Arrangements

Open-bay operatories have a great deal in common with kitchen designs, since both include perimeter cabinets, central islands, and secondary work surfaces. Time-and-motion experts in kitchen design

have established a work triangle based on the location of three constants–sink, stove, and refrigerator–and a convenient mixing area.5 In orthodontics, we have a primary work triangle–formed by the operator, the assistant, and the primary work area (tray)–and a secondary work triangle based on the location of sinks, secondary storage, and mixing areas. The triangle concept is the basis for developing a fluid traffic flow throughout the open-bay operatory (Fig. 2).

Orthodontic staff members work within and at the perimeter of these two triangles. In any office, operators with varying degrees of skill and experience establish what may be called their "individual non-stress tempos". At busy times, doctors and assistants can step up their cadence a notch, but it is not desirable or healthy to work that way for extended periods of time. Under such stressful conditions, patients can be neglected, and the quality of work can suffer. This is not a practice builder.

The open bay is the most popular orthodontic operatory design because it imparts a feeling of openness, enhances communication, and promotes free traffic flow for staff and patients. Experience has shown it to be the most efficient way to handle the volume of patients now seen in orthodontic practices. There are many possibilities for placing various work areas and other functions around the perimeter of the operatory, depending on individual preferences and work patterns (Fig. 3). The axiom for developing any operatory floor plan is that "the work patterns of the doctor and staff determine the final design".6

The chair arrangement should take into account the following factors:

- Size and shape of the available space
- Handicap requirements
- Ability to exploit esthetic exterior views
- Patient comfort
- Economy of square footage

It is remarkable how chair arrangements can save or waste valuable space in an operatory. Traditional parallel or radial designs are economical, requiring only 75-80 square feet per chair (Fig. 4). With adequate distance between chairs and with patients facing a wall or window, these designs also provide a comfort zone where patients feel they have their own territory while in the chairs. Doctors, staff members, and other patients are always behind or to the side of seated patients, and thus the modesty factor for women patients wearing skirts is not violated. If greater privacy is desired (as in adult areas), dividers work well with these chair arrangements (Fig. 5).

Circular or pinwheel chair arrangements are not recommended in offices of less than 2,500 square feet because of their space requirements (Fig. 6). Doctors with larger offices may have the luxury of this type of floor plan, but should consider the modesty factor and other concerns (Table 2).

A corner arrangement of four chairs, requiring only 475 square feet, has all the attributes claimed by proponents of the pinwheel and more (Fig. 7). Central islands can easily be made larger than in circular designs if desired. If tiered cabinetry is needed in the central island, it does not block the observation of other patients. All the chairs can have outside views if windows are present. Traffic flow is far more fluid and unobstructed than in the pinwheel design, and generous handicap-access aisles are easier to incorporate without wasting space. An additional advantage is the modesty factor: the patient is not in constant view of the circulating or on-deck patients.

Adding one more chair at either end, at 75 square feet per chair, still leaves a difference of nearly 400

square feet compared to the five-chair pinwheel. We mentioned the hidden costs of the "30-second difference"; think of the not-so-hidden costs of wasting 400 square feet in the operatory. When leasing at $20 per square foot, the extra expense is $10,000 per year, plus triple net. Even if you own the building, wasted space anywhere in your office increases the bottom line of your mortgage payments.

Chairside Cabinetry and Delivery Systems

One issue that is often overlooked in designing chairside cabinetry is that of ambidexterity. The frequency of left-handed people in our society is approaching 30%, now that children are no longer being intentionally broken of lefthandedness.5 This is a significant factor for orthodontists who plan to take on young associates, or even in hiring chairside assistants. When it comes time to sell their practices, doctors are at a great disadvantage if their chairside equipment is suitable for right-handed operators only. Today, offices are increasingly designed with rear-delivery systems to avoid this potential problem (Fig. 8).

The best rear cabinet design incorporates a movable delivery section that extends easily from the body of the cabinet. This allows at least 18" between the head of the chair and cabinet and avoids the tangle of coiled hose systems that are pulled from the cabinet under considerable tension. The extra operator room provided by an extension system allows the 70-80% of right-handed doctors who use the 10-11 o'clock position to work comfortably, with complete access to the primary work area. Because of the location of the cabinet behind the chair, however, those who prefer to work in the 12 o'clock position should consider a side-delivery system. For those who occasionally like to use the 12 o'clock position, but want the advantages of rear delivery, an easy solution is a dental chair that allows a portion of the fixed base to swivel the patient into a 12 o'clock position.

The most important feature of a side-delivery cabinet is a generous working surface, allowing room for the extra trays needed in unplanned multiple procedures. A "universal" side-delivery cabinet can be used (when properly positioned) in the rear-delivery position as well (Fig. 9). It is thus ambidextrous for use by left-handed operators.

Generic side cabinets are generally one-tray units with limited secondary work surfaces (Fig. 10). They are popular in satellites and starter offices because of their low cost and small size. As busyness increases, however, they breed inefficiency. These small units promote Class VI movements to gain access to support areas. To overcome this problem, orthodontists often have to develop split systems, using mobile cabinets such as band carts or mini-islands to gain more work surface (Fig. 11).

Split systems must be especially well planned to avoid confusing and inefficient work patterns. The solo operator, contending with two primary work triangles that can have a considerable distance between them, has to move the dental stool across the floor to reach the extra cabinetry. In a four-handed routine, the assistant must be highly mobile and usually has to stand. During some tasks, while handing the doctor instruments, the assistant will not have a good view of the oral cavity; conversely, when the assistant has a good view of the oral cavity, the instruments are often not convenient. In addition, the high-velocity suction is usually not in a good position for the assistant to help the doctor. Mobile equipment is a hindrance to an efficient, smooth-running, free-flowing open bay.

Chairside Utility Centers

In orthodontics, there has recently been a resurgence in popularity of the chairside rinsing station. A

chairside utility center is more sophisticated than a rinsing fountain, as it includes a paper cup dispenser, a tissue dispenser, and a trash receptacle as well as a large rinsing bowl (Fig. 12). Rinsing is less of a doctor-time concern than it once was, since many chairside routines are now delegated and long four-handed tasks requiring rinsing are rare.

Adults especially appreciate the convenience of utility centers. With younger patients, they aid in what can be called "crowd control", since patients remain in their chairs once seated. How many times have you or your assistant sat at the chair impatiently waiting for a patient who left to rinse or rebrush? It probably took more than 30 seconds of your time.

Utility centers can be useful if impressions are routinely taken in the operatory. When a patient has a gagging experience, the patient's head can be gently moved to the nearby rinsing bowl. During a long reproximation session, the patient doesn't have to rinse at the toothbrushing area, keeping it cleaner and more sanitary for other patients. Utility centers are also becoming standard equipment in records rooms.

Central Islands

When the size of the operatory permits, central islands can play an important role in an efficient and functional open-bay design. In the past, central islands were often too large and cumbersome, blocking access to treatment chairs and performing functions from cold sterilization centers to welding stations.7 The trend today is to have multiple central islands. Smaller (5-6') streamlined islands, with generous pass-through aisles, serve one or two chairs instead of trying to serve all the chairs in the bay (Fig. 13).

The practice's work patterns must determine the priorities of the island design. Central islands can offer vital secondary work surfaces, and the interiors of the cabinets can be used for items such as mini-refrigerators, storage drawers of varying depths, plumbing and electrical equipment, and computer network servers. If the open bay is spacious, the central islands can be deep enough to have drawers on both sides, adding high-priority storage close to the primary work area. The central island's greatest value is that it keeps the secondary work triangle small and reduces the distance to perimeter cabinets (Fig. 3A).

For well-planned central islands without wasted space, it makes sense to work with a commercial manufacturer rather than a local custom cabinet maker. In the long run, custom cabinetry can be more expensive than the commercial variety. It can also be more frustrating, because providing room for built-in equipment can be an electrical and plumbing nightmare for an uninitiated, well-intentioned local cabinet maker. Lost storage areas are common in homemade cabinets, whereas commercial outfits know the tricks of making good use of every square inch of potential space. The island is just as important to efficient performance as the chairside cabinetry.

Sterilization Centers

The recent emphasis on sterilization has influenced the design of these areas in two ways: More linear counter space is needed, whether it is L-shaped, U-shaped, or straight-line; and to save steps, the sterilization area is more centrally located, as close as practical behind the chairs in the open bay. Because the public is so conscious of sterilization, some orthodontists prefer to have the area completely visible to parents and patients (Fig. 14). Others favor a recessed enclosure, but still make its presence known. When the location is not obvious, doctors often place subtle signage to reassure their patients.

If the main sterilization station has to be located in a remote area, far from the perimeter of the bay, an efficient feeder system is needed (Fig. 15). A tiered central island with shelving can be used to dispense sterilized instruments and to temporarily store used instruments. This cabinet can also serve other functions of central islands, such as priority storage and backup counter space.

Computer Considerations

Many practices use computers in certain areas without being completely "paperless".8 Computers can improve the efficiency of operatory routines through information gathering, scheduling, and traffic control. They can be placed in any of three general locations within the operatory:

- Separate, isolated stations in the bay or on perimeter cabinetry
- Sharing space in central islands
- Chairside, attached to the cabinets or on separate pole mountings

Well-designed side-delivery and rear-delivery units both provide enough room for computer installations, but the rear units have the advantages of screen privacy from the patient's view and more room for installations without infringing on work surfaces. Because of the cost of computers at each chair, however, many doctors are using computers in central islands as an interim step. Some have gone to laptop computers at each chair, which is also a substantial investment.

Many orthodontists have been discouraged from installing chairside units because of the poor design of currently available commercial units. Most are unesthetic, and the bulky, mounted monitors leave little room for work. Figure 16 shows a system that overcomes these drawbacks. It allows the operator to remain seated and comfortably reach the keyboard with a good view of the screen. There is adequate room for a large monitor, although the diminishing cost of flat screens now makes them a practical consideration for chairside use.

Conclusion

In this article, we have focused on design without recommending specific work routines. Even allowing for individual differences, most experienced operators are reasonably time-efficient in removing, bending, and placing archwires. Different operators will produce different amounts of work, but it is impossible to change the doctor's or assistants' internal time clocks, which determine their performance during a sixto- eight-hour working day.

What is possible to change quickly, through design, is the efficiency of the working environment. Operatory changes offer the easiest and most rewarding method of applying the lessons of the "30-second difference" to your advantage. The two most important principles are:

1. A design that improves your work patterns in and near the primary work triangle by upgrading your chairside cabinetry and delivery systems.

2. A design that reduces Class VI movements and the distances to secondary support areas (Fig. 3).

Whether your motivation is the "30-second difference" or the commonsense adage of "greater efficiency = greater profits" is unimportant. If the time is right, make this positive step. By doing so, you will add value to your practice for a future sale, and you will enjoy the benefits as long as you remain in the office. The $25,000 you gain (or don't lose) in one year may cover the necessary changes in your operatory floor plan and the cost of upgrading your chairside delivery systems.

Making changes can be temporarily disruptive, but a well-planned, enjoyable working environment is an investment that provides both daily rewards and annual returns. □

FIGURES

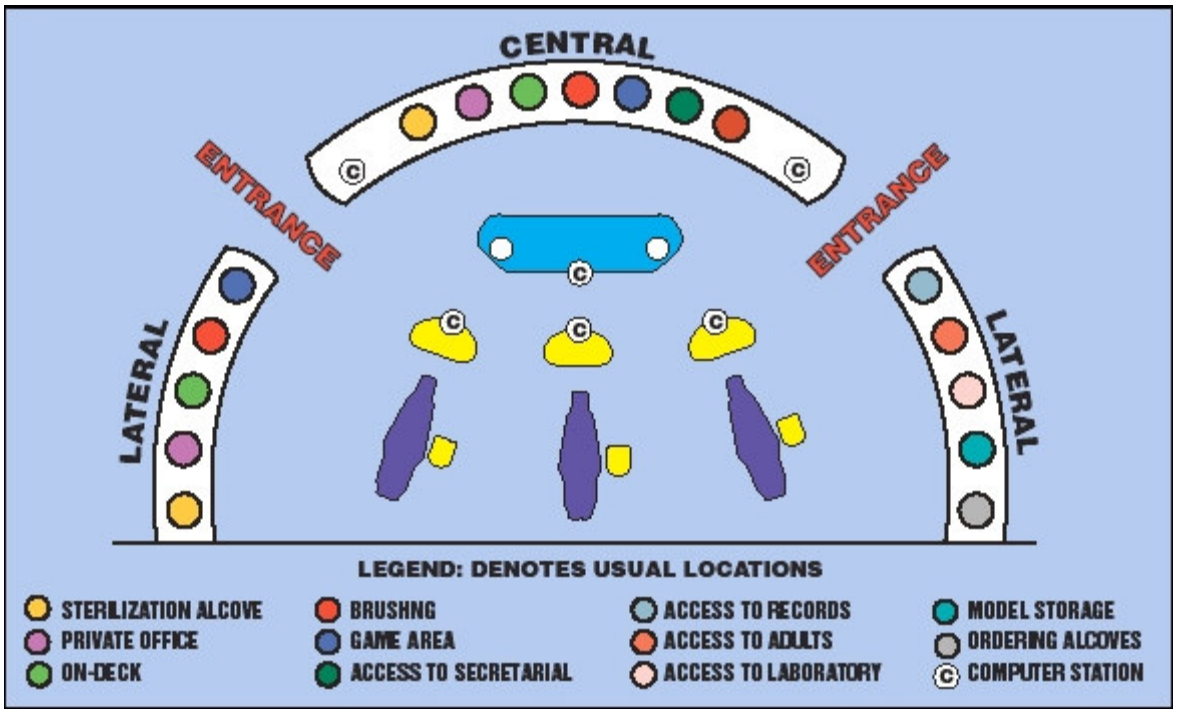

Fig. 1 In rear-delivery system, primary work area can be used for multiple procedures.

Fig. 2 Primary and secondary work triangles in rear- and side-delivery systems (A = assistant; S = sink). Open Bay's Perimeter Possibilities

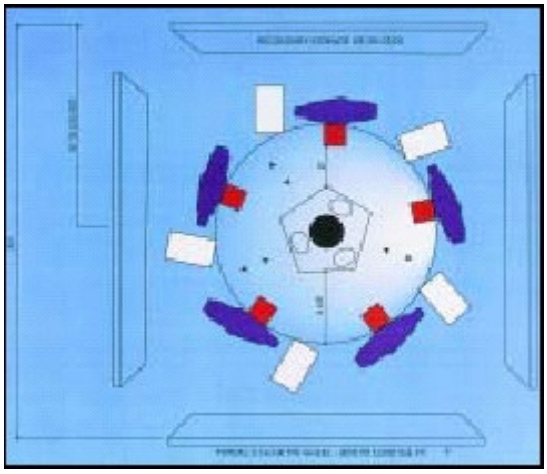

Fig. 3 Possible open bay design, with secondary functions on perimeter.

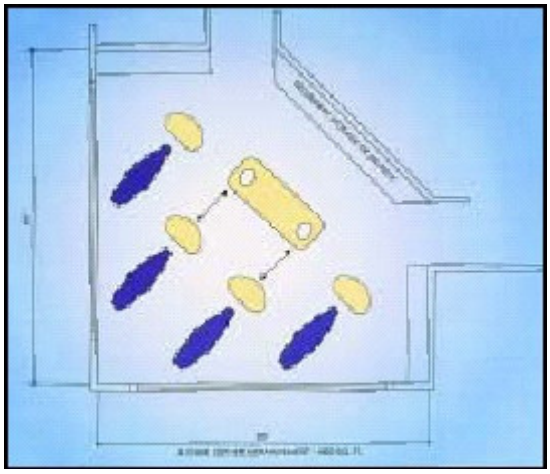

Fig. 4 A. Typical parallel chair arrangement. B. Typical radial chair arrangement.

Fig. 5 Adult area with chairside divider for added privacy.

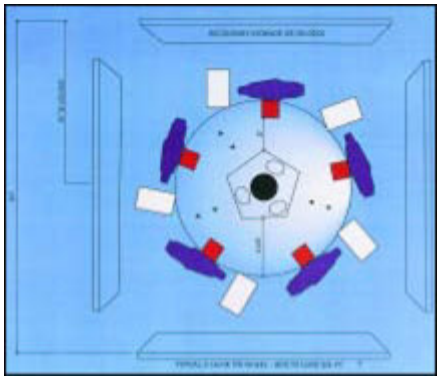

Fig. 6 Typical five-chair pinwheel arrangement, requiring 800-1,000 square feet.

Fig. 7 Four-chair corner arrangement, requiring 475 square feet

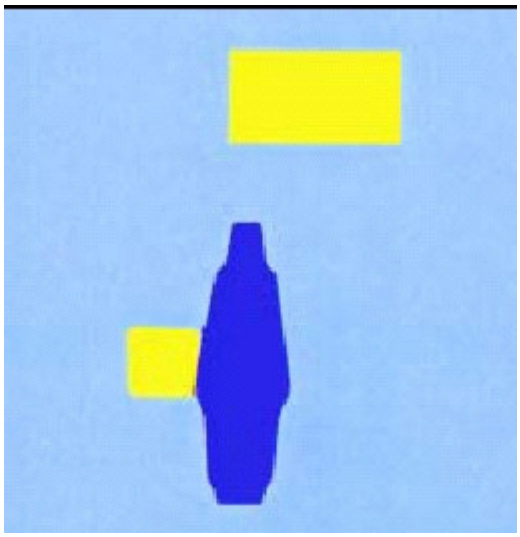

Fig. 8 Four-handed rear delivery with left-handed operator.

Fig. 9 "Universal" side-delivery cabinet with generous work surface (photo courtesy of Boyd Industries).

Fig. 10 Small work surface on side cabinet in tiered pinwheel layout.

Fig. 11 Split system with single-tray side delivery.

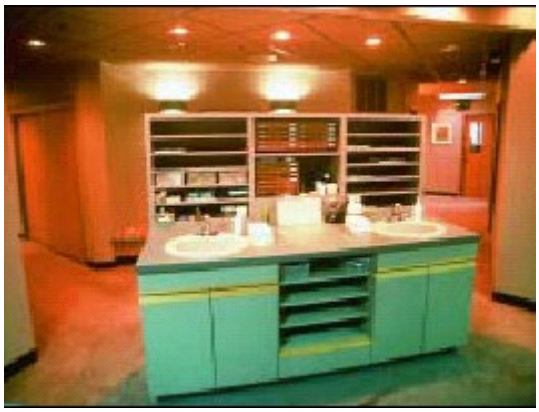

Fig. 12 Chairside utility center.

Fig. 13 Central island serves as secondary work surface for two chairs.

Fig. 14 Open sterilization center with straight-line counter.

Fig. 15 Tiered central island provides feeder system for remote sterilization area.

Fig. 15 Tiered central island provides feeder system for remote sterilization area.

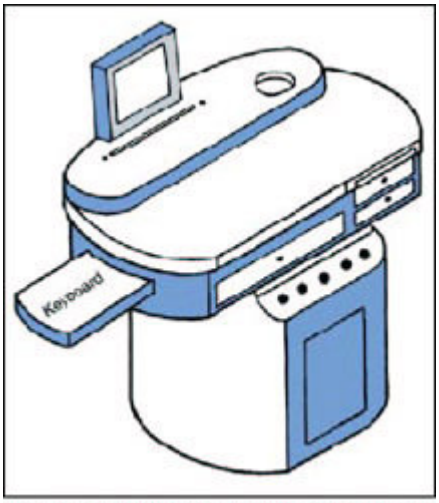

Fig. 16 Rear-delivery design with chairside computer location.

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TABLES

TABLE 1
CLASSIFICATION OF OPERATOR MOVEMENTS

Class I	Fingers only
Class II	Fingers and wrists
Class III	Fingers, wrists, and elbow
Class IV	Fingers, wrists, elbow, and arm
Class V	Fingers, wrists, elbow, arm, and shoulder (often with twisting movements of the body)
Class VI	Movements requiring operator to leave chairside for secondary support to complete task

Table. 1

TABLE 2
DISADVANTAGES OF PINWHEEL CHAIR ARRANGEMENT

- Most central islands have inadequate work surfaces to serve surrounding chairs.
- Limited island work area leads to clutter; central tiered cabinets create "visual noise" that reduces the expansiveness and openness of the operatory.
- Not all chairs can share in outside views.
- Strict interpretation of handicap requirements makes the design difficult to execute. Aisle width may have to be increased, thus increasing the diameter of the circle and wasting even more space.
- No privacy for patients, who are completely surrounded by traffic lanes and in constant view of circulating staff and patients.

Table. 2

REFERENCES

1 Bellavia, D.C.: The Book on Orthodontics, 2nd ed., Bio-Engineering Co., Buffalo, NY, 1991.

2 Hoffman, D.A.: Time and motion study in dentistry, Bull. Gr. Milw. Dent. Assoc. 23:101, 1957.

3 Hamula W. and Hamula, D.W.: Orthodontic Office Design: Rear delivery system, J. Clin. Orthod. 28:547-555, 1994.

4 Demaree, H.L. and Cunningham, P.: The dental facility of the future, Calif. Dent. Assoc. J. 21:25-28, 1993.

5 Kilpatrick, H.C.: Work Simplification in Dental Practice: Applied Time and Motion Studies, W.B. Saunders Co., Philadelphia, 1964, p. 45.

6 Hamula W.: Orthodontic Office Design: Developing a floor plan, J. Clin. Orthod. 18:719-725, 1984.

7 Hamula W.: Orthodontic Office Design: Operatory, J. Clin. Orthod. 12:445-450, 1978.

8 Hamula, W. and Hamula, D.W.: Orthodontic Office Design: The paperless practice, J. Clin. Orthod. 32:35-43, 1998.

FOOTNOTES

1 Boyd Industries, 12900 44th St. N., Clearwater, FL 33762.